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POR-2506
(WT-2506)

Operation

ROLLER COASTER

PROJECT OFFICERS REPORT—PROJECT 2.6a

SPECIAL PARTICULATE CHARACTERISTICS

R. K. Fuller, Project Officer

J. D. O'Connor
M. J. Nuckolls

U. S. Naval Radiological
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San Francisco, California 94135

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ABSTRACT

Some physical and chemical properties of fallout resulting from the high-explosive detonations of nuclear weapons containing plutonium were determined. They included:

(1) The total mass of fallout collected per unit area.

(2) The amount of plutonium and uranium collected per unit area.

(3) The mass distribution of plutonium and uranium by particle size.

(4) The relationships among mass, plutonium content, and density of fallout samples.

(5) The solubility of plutonium under conditions associated with the radiological recovery of contaminated facilities.

The particulate fallout samples from the Double Tracks, Clean Slate I, and Clean Slate II events (DT, CS I, and CS II) were collected on 4-foot-square, petrolatum-coated, aluminum sheets placed upon the ground. They were distributed in a pattern downwind of the detonation point at distances ranging from 100 to 10,000 feet. After removal from the collector panels by a xylene rinse, the particulate was separated by centrifugation. The following data were then obtained: (1) combined gamma and X-ray activity as measured in a well-type NaI crystal counter, (2) total sample weight, (3) mass versus particle size, and (4) activity versus particle size. The plutonium content of each sample was computed from the counting data. (Am^{241}, a concomitant of reactor-generated plutonium, yields a 60-kev gamma ray, and Pu^{239} yields a 17-kev X-ray.)

At the U.S. Naval Radiological Defense Laboratory (NRDL) the plutonium content of samples was measured in two ways. One was by comparing the gamma count rates with calibration standards made from a sample of the plutonium used to fabricate the Roller Coaster (RC) devices. The second was by comparing gamma and X-ray spectra of samples with those of known RC plutonium standards. The plutonium content of a few samples was determined by resolving and comparing photopeaks of fissio. oducts, induced by neutron irradiation, with those induced in standards. Another method was radiochemical analysis done by Project 5.2/5.3 contractors. Comparisons of the averaged plutonium results obtained by each method agreed within ± 20 percent.

The amount of material collected ranged from 0.2 to 6.6 g/m^2 for DT, 0.2 to 28 g/m^2 for CS I, and 0.3 to 2,560 g/m^2 for CS II. In some cases, an unknown amount of desert

soil was blown onto the collectors, making precise measurements of the amount of fallout deposited on each collector impossible.

The amount of plutonium deposited ranged from 0.5 to 1,116 $\mu g/m^2$ for DT, [illegible] to 2,042 $\mu g/m^2$ for CS I, and 3 to 4,670 $\mu g/m^2$ for CS II.

The ratio of uranium to plutonium in unsieved fallout samples was close to that of the original ratio of the weights of the metal used to fabricate the RC devices. The ratio for different particle sizes in sieved samples was not constant, indicating fractionation of plutonium and uranium with particle size.

Of the plutonium in unsieved samples, 1 to 27 percent was associated with very fine particles having a density greater than 4.30; this fraction represented less than 5 percent of the sample weight.

A fallout sample from the 5,000-foot arc from each of the first three events was wet-sieved. Fifty percent of the gamma activity was associated with particles less than 84μ for DT, 195μ for CS I, and 39μ for CS II. In fact, 98 percent of the gamma activity was associated with particles less than 50μ in the CS II sample. There was a general, but not always consistent, decrease in the particle size of samples collected at increasing downwind distances.

Leaching and ion exchange studies showed that the plutonium in the fallout was not dissolved by water alone or water solutions of sodium hydroxide and Orvus. About 10 percent was dissolved by 0.1 N hydrochloric acid, however. When fallout was mixed and allowed to stand with a water slurry of montmorillonite clay, about 6 percent of the activity became associated with the clay.

PREFACE

Permission to participation in the operation and the support given it by the Commander, Pacific Missile Range, and the special interest and support of Mr. Leon Slavin, are greatly appreciated.

The project is indebted to Major Rice T. Trolan, USA, Military Coordinator for Projects 2.1, 2.5, and 2.6a, for his contribution to the field phase, and to Mr. Alfred J. Guay, of the project, who was indispensable in all phases of effort. Mr. Noah J. Vella's assistance as an extra effort in reducing the data is appreciated.

The collection of the gamma spectral data was made possible by the assistance and cooperation of Messrs Herman I. Cordova, Harry A. Goya, and Ming G. Lai of the U. S. Naval Radiological Defense Laboratory (NRDL).

Appreciation is expressed to Mr. W. B. Lane of NRDL who suggested the neutron-activation analytical method to determine plutonium in fallout, and to Mr. H. R. Lukens and Miss D. Fleischman of General Atomic who ably assisted in demonstrating its practicability.

The following Navy personnel participated during the field phase of this project:

SW-1 Douglas R. Lombard, of the Disaster Recovery Training Unit, Davisville, Rhode Island

SWF-3 Ralph Ettleman, UTA-3 Richard Scott, and PNSN Daniel Smith, of Mobile Construction Battalion 5, Port Hueneme, California

CEP-1 Donald J. Frazier and BUR-3 Luke R. Patrick, III, of Mobile Construction Battalion 4, Davisville, Rhode Island

Their enthusiastic assistance and the consent of their commanding officers to their participation are acknowledged with appreciation.

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CHAPTER 1

INTRODUCTION

1.1 OBJECTIVES

The objectives of Project 2.6a were to determine the physical and chemical nature of the fallout resulting from the high-explosive detonations of nuclear weapons containing plutonium. The primary measurements were:

(1) The total mass of fallout deposited per unit area.

(2) The amount of plutonium and uranium deposited per unit area.

(3) The mass distribution of plutonium and uranium by particle size.

(4) The relationships among mass, plutonium content, and density of fallout samples.

(5) The solubility of plutonium in the fallout under conditions associated with the radiological recovery of contaminated facilities.

The objectives and requirements of the project may also be identified in part with the objectives shown for Project 2.6 in Reference 1.

1.2 BACKGROUND

NRDL[1] has the task of providing the Pacific Missile Range with plans for decontaminating and reclaiming facilities that have been contaminated with plutonium as the result of accidents involving missiles bearing nuclear warheads.

There have been no comprehensive studies of the reclamation of a large area contaminated with plutonium fallout, although the decontamination of surfaces with relatively small areas was performed by Program 57, Operation Plumbbob. The reclamation of the Thor pad at Johnston Island in August 1962 was a crash program, and no study of recovery parameters was conducted. In fact, some

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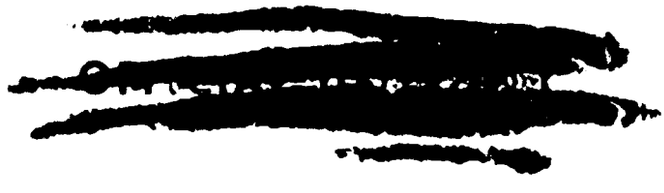
[1] Appendix A is a glossary of abbreviations.



delay was encountered during this operation because various decontamination methods and procedures were found ineffective and better ones were sought and tried. A detailed description of the radiological recovery operation of the Thor pad at Johnston Island is to be found in Reference 2.

The development of a simulant for plutonium fallout would allow engineering-scale recovery experiments to be conducted safely on simulated or real launch complexes to provide information that would decrease the time and cost of reclaiming installations following future accidents.

To this end, a thorough knowledge of the material to be simulated is mandatory. Consequently, acquisition of these data was imperative when it is realized that Operation Roller Coaster was only the second such research operation in which plutonium was to be released under controlled conditions.

This project embraced a system of collection and analysis designed to yield information on the physical and chemical properties of the debris. The proper delineation of these properties required a large sample. For this reason a collector with a large area (4-foot square) with a retentive surface was designed.

In contrast to the analytical techniques used at Project 57, and the radiochemical products employed by Project 5.3, Operation Roller Coaster, the activation analysis proposed for plutonium and uranium was a special technique, developmental in nature, which had not been attempted previously with fallout samples of this type. It was intended to be simpler and less costly than the radiochemical separation and detection procedures usually used for the analysis of plutonium.

Two other nondestructive and relatively simple analytical procedures were used by the project. One was to determine the plutonium in a sample from the total count rate of the 17-kev Pu^{239} X-ray and the 60-kev Am^{241} gamma ray as detected by a NaI well-type crystal. The other was to isolate the activity of the two rays on a multichannel pulse-height analyzer and to determine plutonium indirectly from the activity in the 60-kev Am^{241} gamma ray peak.

1.3 THEORY

The development of radiological countermeasures systems and the measure-

ment of their effectiveness for plutonium contamination require information on fallout that is produced by the nonnuclear detonation of plutonium-bearing weapons. The data needed lie in four areas of study: (1) the chemical and physical characteristics of the fallout, (2) the ground distribution of fallout, (3) the exposure environment, and (4) the alteration of the exposure environment by countermeasures. The analytical data obtained by this project will contribute directly to Area (1).

Past experience with the environment resulting from the destruction of plutonium-bearing devices has been very restricted, hence, generalizations of experimental data in each of the four areas have been severely limited. The limited knowledge in this area must be coupled with empirical and theoretical studies to develop models of the fallout formation process, meteorological distribution process, and the exposure environment in order to develop countermeasure systems that can be used to reduce or eliminate the exposure environment. Fortunately the opportunity to participate in Roller Coaster afforded a means of obtaining new reliable data concerning the nature of fallout from such explosions, particularly data that were pertinent to radiological recovery problems.

1.4 LESCRIPTION OF OPERATION ROLLER COASTER

Operation Roller Coaster was a research program conducted jointly by the AEC and the DOD in cooperation with the AEA (Reference 1). It was a research program to evaluate storage, handling, and transportation criteria for plutonium-bearing weapons. It was conducted on a portion of the Las Vegas Bombing Range and Sandia Corporation's Tonopah Test Range within the framework of the NTSO, even though geographically it was not within the Nevada Test Site. Program management was performed by Weapons Effects and Test Group, Field Command, DASA (Reference 4).

The site layout is shown in Figure 1.1.

The objectives of the operation were (Reference 1):

(1) To obtain, by physical and biological measurements, necessary data

on the plutonium airborne particulate to permit an assessment of the acute (inhalation) hazard.

(2) To measure the distribution of plutonium on the ground to permit detailed accountability of the amount involved in the field of measurement.

(3) To evaluate the total effectiveness of the structures, including varying thicknesses of earth cover, for reducing the radiological hazard from a real accident.

(4) To obtain those data of special importance in forecasting the hazard arising from a real accident (cloud models).

The operation consisted of four events: Project 2.6a participated in only the first three.

The Double Tracks event was an experiment to investigate the biological hazard of scattered plutonium. The Clean Slate events comprised an experiment to evaluate the plutonium-scavenging effects of earth-covered storage structures and the hazard reduction resulting therefrom.

The DT device was elevated 1 foot above a steel-faced concrete surface and was one-point detonated (side). It contained plutonium and depleted uranium (depletalloy).

The Clean Slate I event represented an accident occurring under open storage conditions. It consisted of nine devices supported 1 foot above a concrete pad. The center device was identical to the DT device, while the eight surrounding devices contained only depletalloy. They were detonated in sequence similar to that expected if actual propagation by concussion from the explosion of the center device had occurred.

The Clean Slate II event represented the accidental detonation of 19 devices occurring in a DASA storage igloo covered with 2 feet of earth. Again, only one device contained plutonium.

The Clean Slate III event, in which Project 2.6a did not participate, was similar to Clean Slate II except that the igloo was covered with 8 feet of earth.

The projects and offices pertaining to the scientific phase of the operation are shown in Figure 1.2.

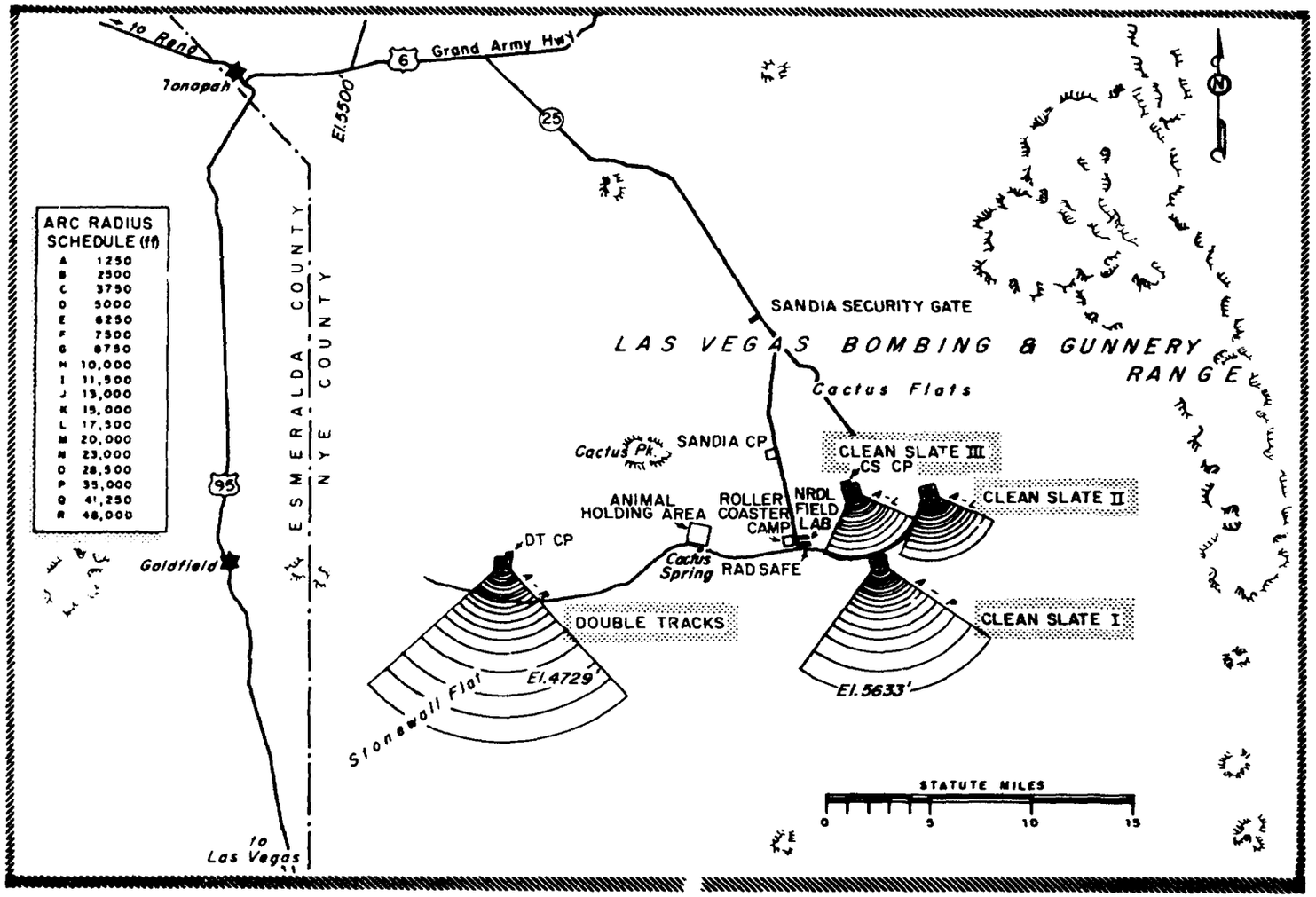


Figure 1.1 Roller Coaster site layout.

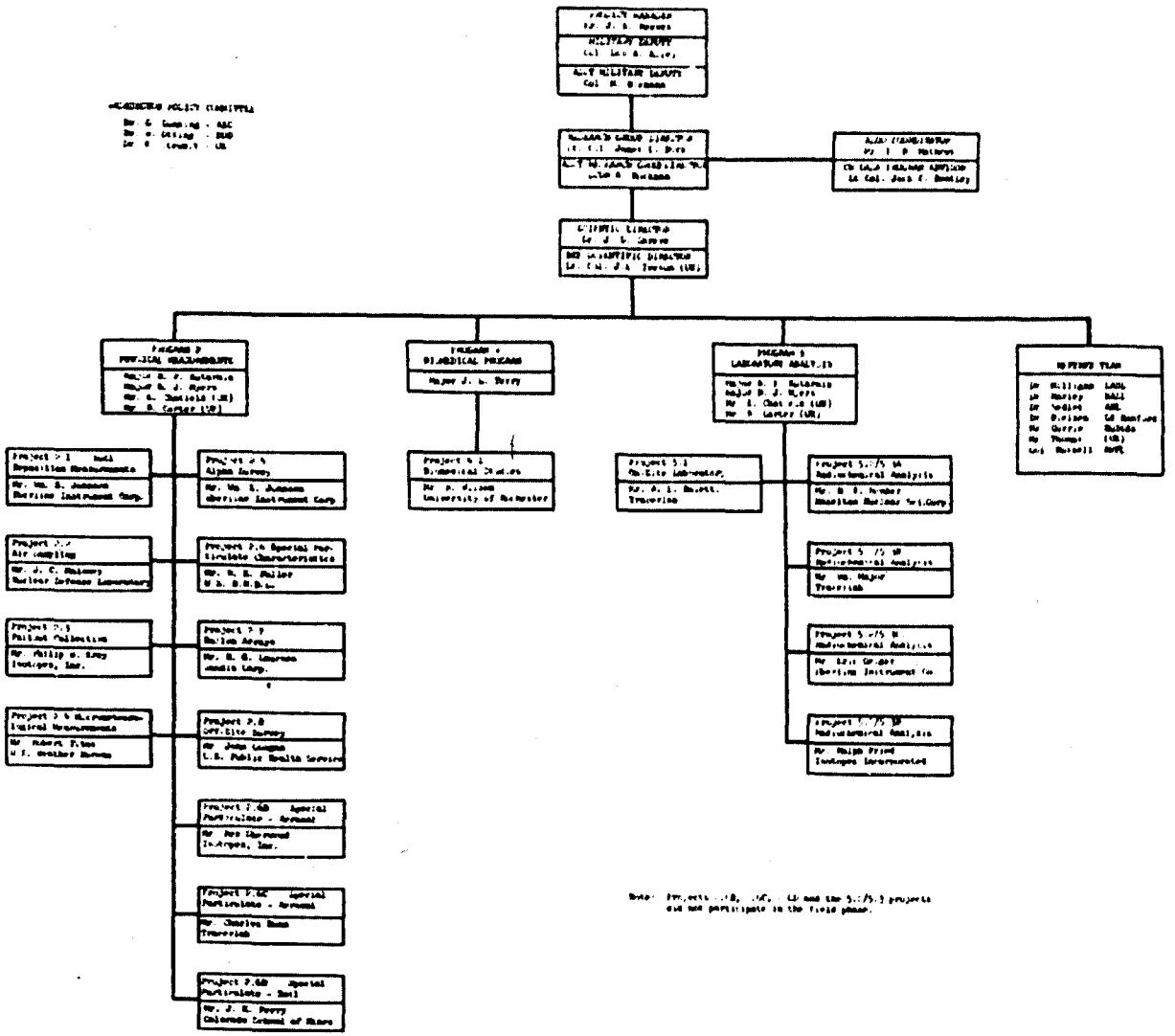


Figure 1.2 Roller Coaster organization chart.

CHAPTER 2

PROCEDURE

2.1 PLANNING

Project 2.6a planned to participate in three events, Double Tracks, Clean Slate I, and Clean Slate II. The primary purpose of the field phase of this project was to collect samples with sufficient quantities of particulate fallout for analytical study. The planned placement of the large-area fallout collectors was based upon fallout patterns predicted from data in References 5 and 6. Collector stations were to be so located that approximately half the stations (with two collectors) were within the expected 1,000-$\mu g/m^2$ contour (1,250 feet downwind), while the other half with four collectors were located between 1,250 and 5,000 feet. They were arranged to cover a 45-degree included angle that was symmetrical about the expected downwind centerline. The collectors were easily portable so that the array could be moved quickly in case of late wind shifts.

Pre-field-phase information had indicated that zero time for the events would occur during the middle morning hours, so no provisions were made by the project for night operations. Furthermore, the number of personnel and the amount of equipment taken to TTR were based upon a 2-week interval between shots as specified in Reference 7.

Project 2.6a planned to be as self-sufficient in the field as possible and to require a minimum amount of material or personnel support from DASA or REECO. Construction and space requirements were also minimal. No demands were made of the support organization except for stenographic assistance, two ¾-ton Army trucks, minor carpentry work, and two packers during rollup.

In the interest of economy and flexibility, sample-collector supports in the array were eliminated. Laboratory space was not needed because the counting

trailer and its adjacent open-air sample processing facility were outfitted and prefabricated at NRDL and required only to be connected to electrical power to become operative. Project personnel at TTR at any one time consisted of one project officer, two laboratory technicians experienced in field operations, and three Sea Bees. Six months before the field phase began, arrangements for the military personnel were made with the Commanders of the Navy Construction Battalions and the Disaster Control School.

Laboratory work at the site and at NRDL had been planned to include only one fallout sample from each of three downwind distances for each of three shots, making a total of nine samples. The fallout samples were counted in a well-type NaI crystal that detected the 17-kev Pu^{239} X-ray and the 60-kev Am^{241} gamma ray. Gamma counting offers a fast, nondestructive method of measuring plutonium in fallout. It is not possible to determine the plutonium content of soil or of fallout samples by alpha counting. Detecting the presence of plutonium with a gamma probe[2], even when the ground is wet or covered with oil, was done successfully at Johnston Island in 1962 (Reference 2) and was the previous experience that led to the use of this procedure.

The original plans explained in Appendix B called for measuring the gamma activity in neutron-irradiated DT fallout samples after the short-lived activities induced in the natural elements of the soil had decayed. Subsequent plans for participation in CS I and in CS II (with higher uranium-to-plutonium ratios) and the discovery that a fairly high uranium content existed naturally in Nevada soil required the development of the more sophisticated neutron-activation analysis that was actually used.

The relationships of mass and activity to particle density and particle-size distribution, as well as the susceptibility of plutonium to leaching, are important

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[2] The Eberline Instrument Company (EIC) PG-1 probe is a thin NaI crystal detector that can be connected to the body of a PAC 1SA alpha survey meter in place of its alpha probe. This allows the 17-kev Pu^{239} X-ray and the 60-kev Am^{241} gamma ray to be detected.

characteristics of fallout to be considered when preparing a simulant for plutonium fallout and when planning radiological recovery after a one-point accident.

2.2 WEATHER DATA AT SHOT TIME

Table 2.1 presents pertinent weather data at shot time (Reference 3).

2.3 FACILITIES

2.3.1 Facilities at TTR. The Project 2.6a sample processing and analytical facility at TTR was located near the main camp within the Rad-Safe exclusion area. The 2.6a facility consisted of an open-air shelter and a trailer (see Figure 2.1).

A prefabricated tent attached to the counting trailer was designed to shelter personnel and samples from wind, rain, and sun but to allow ample ventilation for personnel who were removing fallout from the collectors with xylene. Personnel working with xylene were required to wear a standard, all-service, full-vision face piece, MSA gas mask (EA 77705) equipped with an ED 3045 canister to prevent their inhaling xylene vapors (see Figure 2.2).

The samples were gamma-counted and weighed in the trailer. All other sample processing and preparation was performed in the canvas shelter.

2.3.2 Facilities at NRDL. Only sealed containers of fallout were handled at NRDL where the gamma counter and 400-channel pulse-height analyzer were located, hence no facilities other than those of a standard laboratory were required.

2.3.3 Facilities at Camp Parks. A laboratory was set up to process the Roller Coaster fallout samples at Camp Parks, 40 miles east of San Francisco. It contained a glove box, enclosing an analytical balance, and the equipment for wet sieving, dry sieving, and density separations.

2.4 INSTRUMENTATION

2.4.1 Large Area (Aluminum) Particulate Fallout Collectors. The large area

fallout collectors were designed to insure the collection of a sufficient amount of fallout material and to increase the probability of obtaining a representative sample (see Figure 2.2).

The basic collector was developed and used successfully at the Small Boy event of Operation Sun Beam. It consisted of a 4- by 4-foot sheet of aluminum foil, 0.003-inch thick, surfaced with a thin coat of petrolatum and mounted on a ¼-inch-thick masonite panel. Before being shipped to the TTR, a thin film of petrolatum was applied to the aluminum collector faces to act as an easily removable adhesive for fallout. The petrolatum was applied at NRDL's Camp Parks Field Facility by spraying a 25-percent xylene solution of petrolatum onto the aluminum surface with a commercial (DeVilbiss) paint spray gun.

Except for the period of exposure in the fallout array, the collectors were stored, transported, and handled in pairs, with the petrolatum-covered faces mated to prevent contamination of the collecting surfaces by extraneous materials.

2.4.2 Sample Preparation at TTR. An Eberline PAC 3G alpha survey instrument was borrowed from Project 2.5 for monitoring the aluminum collectors during recovery and during sample processing. This instrument was calibrated using a large-area (120 cm^2) Pu^{239} source with the activity evenly distributed over the surface. (This is in contrast to the usual practice of using a 1-inch-diameter source.) The source strength was 1,280 ± 30 alpha dpm emitted upward (2π) from the surface of the source. The instrument was adjusted to read 640 ± 15 counts/min on the "1×" scale when held ¼ inch above the surface of the oblong calibration source. The "10× and 100×" scales were similarly calibrated. This calibration resulted in an instrument that read 25 to 30 percent low when checked with a 1-inch-diameter Pu^{239} source.

The teflon-covered wash rack in Figure 2.3 supported each aluminum collector as it was monitored and washed free of fallout with xylene. Inside the air-conditioned trailer were a Mettler B5 analytical macrobalance and a Mettler K5 high-speed balance. The first separation of fallout from xylene was done in a Size 2 International centrifuge (Figure 2.4). It was equipped with a head that

accepted four 500-ml centrifuge bottles. A smaller Baker-Adams clinical centrifuge was equipped to handle four 40-ml centrifuge tubes.

2.4.3 NaI Crystal Counter (Well-Type). At TTR the counter consisted of a 3- by 3-inch cylindrical NaI (T1) crystal with a $1\frac{1}{4}$-inch diameter by $2\frac{1}{4}$-inch deep well lined with 0.032-inch-thick aluminum. The crystal and its optically-connected EMI phototube and TMC transistorized preamplifier were enclosed in a 4-inch-thick lead shield. The pulses were recorded by a Systron 1091-3 scaler operated from a Model 12 John Fluke power supply.

At NRDL the gamma counting system was essentially the same as described above, except a different TMC preamp and Fluke power supply were used. The scaler was replaced with a Berkeley Digital Scanner, Model 1556S. All counting was done with 10 grams or less of material contained in a 40-ml centrifuge tube, which, in turn, was protected by a 100-ml Lusteroid tube as shown in Figure 2.5.

2.4.4 400-Channel Pulse-Height Analyzer. The gamma and X-ray spectra obtained, using the same detector system, were analyzed by connecting it to a TMC 400-channel pulse-height analyzer. The data were recovered in digital form as well as being displayed on a Mosely X-Y plotter (see Figure 2.6).

2.4.5 Particle-Size Analyses. Sieves with mesh openings lower than 44μ (325 mesh) were 3 inches in diameter and made of stainless steel by the W. S. Tyler Company (see Figure 2.7).

Three-inch-diameter BMC Micro Mesh Sieves with mesh openings of 40, 30, 20, and 10μ (see Figure 2.8) (manufactured by Buckbee Mears Company, St Paul 1, Minnesota) were used to increase the range of wet-sieve particle-size analyses.

A Schallfix 120-cps sonic vibrator, distributed by the United Specialties Company, Chicago, Illinois, was used to increase the efficiency and speed of wet-sieving the small particles through a 325-mesh (44μ) sieve (see Figure 2.8).

An Autosonic Model PA 1001, 100-watt output, 27 kc/sec, ultrasonic generator, manufactured by Powertron Ultrasonics Corporation, Garden City, Long

Island, New York, was used with the BMC microsieves (see Figure 2.8) to reduce the time required to wet-sieve particles less than 44μ.

A Ro-Tap sieve shaker, manufactured by the W. S. Tyler Company, was used in conjunction with 3-inch-diameter Tyler sieves for dry-sieve particle-size analysis larger than 325 mesh (44μ) (see Figure 2.7). The Ro-Tap was enclosed in a dust-proof box to reduce noise and the dispersal of plutonium-laden aerosol.

2.4.6 Neutron-Activation Analyses. The neutron-activation analyses were performed by Activation Analysis Service, GA. Their equipment consisted of a Mark I TRIGA reactor and a 3- by 3-inch NaI (well-type) crystal detector connected to a TMC 400-channel pulse-height analyzer.

2.4.7 Photomicrographic Equipment. Photomicrographs of sieve fractions of Sample DT D-050 were taken to visually verify the effectiveness of wet sieving to separate discrete particle sizes. A Bausch and Lomb microscope, a Silge and Kuhn Orthophot, and $2\frac{1}{4}$- by $3\frac{1}{4}$-inch Kodak Panatomic-X film were used.

2.4.8 Density Separation. Fallout was mixed with Clerici solution, which is a homogeneous solution of thallium formate and thallium malonate with a density of 4.30/27° C. The tube containing the above suspension was centrifuged to separate the fallout into two density ranges. The tube was frozen with liquid nitrogen and split into two parts, with the lower part containing the more dense fallout particles.

After thawing, the particles in each density range were recovered on an HA millipore membrane (0.45-μ pore size) (see Figure 2.9).

2.5 FIELD OPERATIONS AT TTR

After arriving at TTR the only modification in the operations plan was necessitated by the revised event schedule that called for all events to occur at night. Although not a serious problem, it did require the hurried acquisition of lanterns and warm clothing, and necessitated several full-scale dry runs at night to expose and recover the sample collectors.

The field phase was compressed from the 75 days planned in Reference 7 to an actual time of about 60 days. Scheduled time between events was reduced from the planned 2 weeks to 1 week. Project 2.6a personnel arrived at TTR on 15 April 1963; the DT event occurred on 15 May 1963, CS I on 25 May 1963, and CS II on 31 May 1963. Personnel departed the test site on 20 June 1963.

Project 2.6a greatly expanded its participation after arrival in the field. The temptation to gather all possible samples and to glean all possible data from this operation was too great for project personnel to resist. Instead of putting collectors at 36 stations for each event as had been planned, the sampling effort was voluntarily expanded to 57 stations at DT, 72 at CS I, and 69 at CS II. Instead of processing only three samples from each event, data were obtained from 30 samples from DT, 22 from CS I, and 64 from CS II. Eleven samples from DT, 10 from CS I, and 7 from CS II were returned to NRDL for more thorough analyses.

2.5.1 Placement of Sample Collectors. Preshot operations were nearly identical for each event. Between D−7 and D−2, each station was marked with a stake and a sign and the ground surface cleared of rocks and mesquite (see Figure 2.10). For stations within the ground-zero grid array, each station was also marked with a flasher signal (see Figure 2.11), because stations in this area were much harder to locate at night than were those beside established arc roads. During this pre-event period, the collectors panels were numbered and loaded into transportation boxes in proper sequence (see Figures 2.12 and 2.13). Collectors placed at stations 100 and 200 feet from ground zero were tied down to stakes driven into the ground; all others were merely laid on the ground. In addition to the dry runs conducted by the Scientific Director and the Research Group Director, one full-scale dry run for collector exposure and recovery was conducted at night before each event with expendable or simulated collectors.

During the time between H−4 and H−1 hours, the collector panels were exposed at each preselected station. The six Project 2.6a men at TTR were separated into two crews of three men each, with each crew being responsible for exposing and collecting approximately one-half of the collectors.

The first scheduled shot night for DT and for CS I was cancelled after the collectors had been exposed for about 8 hours. Although Project 2.6a personnel reclaimed the collectors within 2 hours after the events had been cancelled, as much as 30 grams of desert sand had been deposited on each collector by the high winds and vehicular traffic during exposure. In addition, the collectors were exposed on shot nights for between 8 and 11 hours. These exposures of the collectors resulted in nonfallout sand being deposited on many of the collectors. There was no possible chance to clean or replace the collectors, consequently, the data on mass-of-fallout deposited may not be as precise as hoped.

2.5.2 Recovery of Sample Collectors. After the shot, permission to enter the contaminated fallout area was delayed until Program 2 and the Scientific and the Research Group Directors, respectively, were assured that there had been no fission and that no unexploded HE fragments remained in the vicinity of ground zero. Entry was further delayed until they had received the initial gamma-scan and alpha survey data from Project 2.5. Permission to reenter and recover samples was granted about H+2 hours, R-hour being declared then.

Once R-hour had been declared, no delay was encountered by project personnel because they were completely dressed-out and only required time to don their Mark 17 full-face gas masks before proceeding through the RCP into the fallout array.

Rad-Safe dress-out is shown in Figure 2.14 and consisted of:

(1) A suit of anticontamination coveralls with all openings closed. The pants legs were inserted into a pair of rubber boots, and surgeon's gloves were taped over the sleeves at the wrists.

(2) An outer suit of coveralls was taped over the boots and taped over the surgeon's gloves. All openings were sealed with masking tape.

(3) A Mark 17 gas mask that was tested for leakage on the wearer with titanium tetrachloride.

(4) A hood to cover the head, with the neck flap tucked between the inner and outer suit of coveralls.

(5) Cotton gloves and canvas booties.

As soon as the data from Project 2.5 defining the limits of the fallout pattern were available, Program 2 relayed the results to Project 2.6a by radio. This reduced the time and effort necessary for recovery by eliminating the necessity to examine uncontaminated collectors.

Each sample collector was monitored in two places with an Eberline PAC 3G alpha survey meter (Figures 2.14 and 2.15); samples exhibiting over 100 cpm were recovered.

The petrolatum-covered surfaces of each pair of aluminum collectors were mated, and the pair was slipped into the recovery box on the truck. Care was exercised to prevent losing any sample from the top collector by inverting it over the lower collector (see Figure 2.2) rather than over the ground. Special care was taken when approaching or monitoring the collector to avoid kicking soil onto the collector surface with the canvas booties.

The recovery boxes were covered with polyethylene to prevent their becoming contaminated during recovery. The vertical door was dropped into position and covered with a flap of plastic to reduce contamination of the outside of the box by resuspended fallout while the recovery crew moved from one station to another.

When the Rad-Safe facility was reached, the polyethylene cover was stripped from the recovery box and the box and its contents forklifted to Project 6.2a's nearby sample processing facility.

2.6 ANALYTICAL OPERATIONS AT TTR

2.6.1 Preparation of Samples. The fallout was first removed from the collector. Each sample was then counted, weighed, dry-sieved, and recombined. In addition to the high mass loadings expected on samples within the CS II throwout area, the downwind samples contained more material than anticipated because of the unexpected presence of significant amounts of nonfallout desert sand on the collectors; this increased the amount of time and effort required to process samples.

Each contaminated collector was removed from its recovery box and placed upon the teflon-covered wash rack (see Figure 2.3) and was monitored at nine points with an Eberline PAC 3G alpha survey instrument. The fallout and petrolatum were washed into the attached teflon-lined trough by spraying the collector with approximately ½ liter xylene from a DeVilbiss paint gun. The collector was again monitored at the same nine points to ascertain if all (or almost all) the active material had been recovered from the collector (see Appendix C).

The xylene, petrolatum, and fallout from all collectors (usually two from each station) were washed through the drain into a 1-gallon glass jug. The trough was monitored to detect any fallout retained in the trough; if so, the trough was washed with a xylene spray until less than 400 cpm (PAC 3G) remained.

The solid fallout was separated from the liquid by centrifuging at 4,000 rpm (3,200 times gravity) in 500-ml centrifuge bottles for 20 minutes. All liquid was centrifuged before decanting. The residue (fallout) in those bottles was rinsed with xylene into 40-ml centrifuge tubes with a limit of 10 grams of fallout per tube. After the second wash with xylene, the tubes were oven-dried overnight at 90° C. Aliquots of the supernatant xylene from the most active sample from each DT arc and grid were evaporated to dryness and counted to determine if any fallout had remained suspended in the xylene.

Samples from stations near the CS II bunker were covered with several inches of throwout from the earth cover of the bunkers. At the NRDL processing facility this throwout was allowed to slide off the collectors into an aluminum-lined trough, whence it was transferred to 1-liter, screwcapped, widemouthed bottles. The identifying letter "(a)" was suffixed to the sample designation number (e.g., CS II-BL-10(a)), and the sample was carried through the sample processing and analytical sequence separately from samples similarly marked "(b)" (e.g., CS II-BL-10(b)), which designated the material recovered by washing and centrifuging with xylene as described above.

When counting, weighing, and sieving were completed, the samples from each event were divided into three groups: one was delivered to Project 5.1a for inclu-

sion in the Roller Coaster sample pool with the samples from all the other projects, one was sent to NRDL, and one was divided between Projects 2.6a and 5.1a.

Before leaving TTR, all samples were sealed in 40-ml centrifuge tubes with No. 5 rubber stoppers. Masking tape was then placed around the lip and the sealed tube slipped into a 100-ml Lusteroid tube which, in turn, was sealed with a No. $6\frac{1}{2}$ stopper.

The 1-liter bottles (a maximum of 600 grams per bottle) containing the large CS II throwout samples were sealed in plastic bags and wrapped with packing material before being boxed and shipped.

Samples to be returned to NRDL were carefully packed to prevent tipping. This was fortunate because it was later discovered that the pouring spout allowed a little leakage from the centrifuge tube into the Lusteroid tube if the tubes were inverted. No leakage from the Lusteroid was detected, however.

A better sealing technique was developed after the operation was over. The sloping sides of a No. 5 rubber stopper were lightly wetted and the large end forced into the tube until it was below the pouring spout. Added security from leakage was obtained by filling the void between the upper, narrow end of the stopper and the glass tube with melted deKhotinsky cement or by wrapping the stoppered end with tightly stretched Parafilm.

2.6.2 Sample Weighing. The entire fallout sample from each station was weighed. Small samples were transferred to tared weighing paper and weighed on the analytical balance (accurate to ±0.0005 gram). Large samples were weighed in a tared scoop on the high-speed balance (accurate to ±0.005 gram).

2.6.3 Gamma and X-Ray Counting. A 10-minute background count was taken every 2 hours, and two 1-minute counts of background and plutonium standards were made after every tenth sample. The average of all background and standard counts is shown in Table 2.2.

Each sample, or representative fraction thereof, counted at TTR was con-

tained in a 40-ml glass centrifuge tube that was, in turn, enclosed in a protective, unbreakable Lusteroid test tube. No tube contained more than 10 grams of material. Two 1-minute counts were recorded for each sample, and the mean of these two counts was used thereafter.

Samples counting more than 500,000 cpm were split, and the parts were counted separately to eliminate coincidence corrections. Samples weighing more than 10 grams were split to reduce geometry corrections. The total activity of the sample was obtained by adding the activities of the individually counted fractions.

It was not physically possible to determine the activity of large throwout samples from stations near the CS II bunker because this would have required an inordinately large number of 10-gram aliquots. Instead, a sample, as representative as possible, was weighed and counted, and the activity of the total sample was calculated therefrom.

The plutonium counting and calibration standard was prepared from a solution made up to contain 105 μg of Pu^{239} per cc from a 17.0-mg/cc nitric acid stock solution. This plutonium was not a sample of the plutonium used to fabricate the RC devices. One cc of solution was pipetted into a 40-ml centrifuge tube and evaporated to dryness at 85° C. The tube was sealed with a rubber stopper and deKhotinsky cement and inserted into an unbreakable Lusteroid test tube. The counter response at TTR to this standard is shown in Table 2.2.

The plutonium content of a fallout sample was easily calculated as shown:

$$\frac{\text{Pu content of fallout sample}}{} = \frac{\text{Pu content of standard (105 } \mu\text{g)}}{\text{activity (cpm) of standard}} \times \frac{\text{activity of fallout sample (cpm)}}{}$$

There were no corrections made for sample geometry (except to limit sample size to 10 grams) or for any possible self-absorption.

2.6.4 Dry-Sieve Analysis. The 3-inch sieves, used for all sieving operations, functioned properly only for samples of less than 10 grams; hence, samples weighing less than 10 grams were dry-sieved in their entirety. Samples weighing more were represented by aliquots.

Each sample selected for sieving was counted and weighed and poured onto the top (24-mesh) sieve of the nest. Samples containing mesquite branches and chunks of concrete or rocks were passed through a 5-mesh (4-mm) sieve to remove material that was awkward to handle and was obviously not fallout. This was the only pretreatment of any samples. The joint between each sieve making up the nest of five was sealed with masking tape to prevent an aerosol being generated during sieving. The nest was inserted into the Ro-Tap and sieved for 20 minutes.

After sieving, each fraction was brushed onto a sheet of weighing paper, weighed, poured into a 40-ml centrifuge tube, and counted. The sample was then reconstituted in a single tube.

On rainy days when the relative humidity was above the usual 10 to 20 percent, all samples and sieves were dried at 110° C immediately before sieving.

2.7 ANALYTICAL PROCEDURES AT NRDL

2.7.1 Gamma and X-Ray Counting. Calibration standards were made up in 40-ml centrifuge tubes to contain various known amounts of Roller Coaster plutonium, purified Pu^{239}, and purified Am^{241}. (See Table 2.5 for analysis of Roller Coaster plutonium.) A series of samples of each of these isotopes was mixed with various weights of soils to provide data on self-absorption and sample geometry. To prepare these soil samples, predetermined volumes of dilute acid, that would just be absorbed by the soil without leaving a supernate, were added to the tubes before the soil.

Each liquid standard was counted, the soil was added, the mixture dried at 85° C, and the sample recounted. There was no difference between these two counts. It was, therefore, concluded that the water in the moist samples did not absorb any of the radiation, and that the distribution of the activity was not changed during drying by migration through capillary action.

As at TTR, samples weighing over 10 grams or counting more than 500,000 cpm were split into fractions weighing or counting less than these maxima to

overcome errors from geometry and coincidence.

2.7.2 Pulse-Height Analyses of Gamma and X-Rays. The TMC 400-channel pulse-height analyzer was calibrated with standards (described in Section 2.7.1) to yield the maximum response for both the 17-kev Pu^{239} X-ray and the 60-kev Am^{241} gamma ray. The analyzer was adjusted to have the 17-kev and 60-kev photopeak maxima appear in Channels 48 and 126.5, respectively.

The locations of the photopeak maxima were shifted by count rate and instrument instability. It was, therefore, necessary to briefly scan each sample to determine the adjustments of the photomultiplier and baseline potentiometers required to cause the peaks to fall within Channels 47 to 49 and within 125.5 to 127.5. The sample was counted for as long as necessary (with a limit of 40 minutes) to obtain an accurate count.

There is a small contribution to the count rate of the low energy peak from the 19-kev Am^{241} X-ray which shows up as a shoulder on the right side of the 17-kev Pu^{239} peak as seen in Figures 2.16 and 2.17. It is obvious from these figures that the 52-kev Pu^{239} gamma ray does not contribute a significant amount of activity to the Am^{241} peak.

2.7.3 Wet-Sieve Particle-Size Analyses. Four samples from each event that had been dry-sieved and recombined at TTR were returned to NRDL for wet-sieving. Each sample was transferred from its 40-ml centrifuge tube to a 325-mesh sieve and washed with a stream of water until the water passing through the sieve into the collecting beaker was clear. A Schallfix sonic vibrator was attached to the sieve to decrease the volume of water and the time required for each sample. The screen and the $+44$-μ fallout retained on it were dried at 90° C and the fallout recovered, weighed, counted, and dry-sieved. Each fraction was then weighed and gamma-counted.

The water containing the -44-μ material was centrifuged and the supernatant liquid separated, evaporated to dryness, and gamma-counted. The -44-μ fallout material was counted, dried, and weighed.

The −44-μ material from two samples from each event was subsequently sieved through a series of 40-, 30-, 20-, and 10-μ micromesh sieves. This procedure was somewhat more difficult and tedious than using the 325-mesh sieve because of the very slow flow rate. Vacuum was contraindicated because it caused clogging. Hand tapping and the Sc illfix did not help. The time required was drastically reduced by employing ultrasonic energy. The −44-μ material was washed from its 40-ml tube onto the top surface of the 40-μ micromesh sieve. The sieve was set into a beaker containing enough water to just cover the surface of the screen and to provide liquid coupling between the transducer and the particles. The beaker was set into 3 inches of water in the ultrasonorator tank. A stream of water was directed from a wash bottle into the sieve. As the water level rose in the beaker, the sieve was judiciously raised so that coupling was maintained, but water did not flow over the edge of the sieve back into the sieve.

After about 3 minutes, the sieve was removed and placed in a clean beaker, and the procedure repeated twice. No material was observed to pass through the screen in the third beaker. The wash water and the −40-μ material was similarly and sequentially passed through the 30-, 20-, and 10-μ sieves. The water was separated from the −10-μ material by centrifugation. The sieves and their contents were dried and the contents recovered, weighed, and counted. The water was evaporated to dryness and counted.

The photomicrographs which appear in Appendix G were taken to qualitatively evaluate the efficiency of wet-sieving.

2.7.4 Solubility and Ion Exchange of Plutonium. DT Samples AH-06, AH-07, BK-09, and BL-09 were selected as sources of fallout for these stations because of their high specific activity. Each sample was dry sieved through 200-mesh (74-μ) sieves. The +200-mesh material from all four samples was mixed together and 1.0000-gram aliquots placed into 40-ml centrifuge tubes. These were gamma-counted and then mixed with 10 cc of liquid and, if appropriate, with 10 grams of −325-mesh (−44-μ) highly absorptive montmorillonite clay

(see Table 2.3). Agglomerates were easily dispersed by manual stirring.

After standing for the designated length of time (1 day to 1 month), the samples were gamma-counted and separated. The fallout was easily separated from the supernatant liquid by centrifugation. The clay was separated from the fallout in the water-plus-clay sample by washing it through a 250-mesh (63-μ) sieve. The clay was then separated from the water by centrifugation. The separated fallout, clay, and water were placed in an oven until dry, and then all three fractions were counted and analyzed on the TMC.

The extra 1-day water sample in Table 2.3 was sieved and centrifuged as it it had contained clay. This was done to determine whether the activity observed in the clay of the water-plus-clay sample was due to ionic transfer of the plutonium from the fallout to the clay or whether it was due to fine particles of plutonium oxide being washed through the sieve with the clay. The -200-mesh (-74-μ) fallout material from the four sieved DT samples was combined into 1.0000-gram aliquots. They were counted, mixed with liquid as shown in Table 2.4, and generally treated as described above for the $+200$-mesh material. Clay was not used here, however, because there was no way to separate the clay from the fallout.

2.7.5 Density Separations. One-gram or half-gram aliquots of fallout samples from each event were counted and mixed with 20 ml of Clerici solution in a 40-ml centrifuge tube until agglomerates were dispersed, and the fallout was thoroughly wetted. The tube was centrifuged for 20 minutes, and the suspension was restirred to disperse any agglomerated material. The sample was then centrifuged for 1 hour and allowed to stand overnight.

The contents of the tube were frozen by immersing the tube in liquid nitrogen. The tube was warmed slightly under running water and the frozen cylinder slid out, leaving about 1 cc of frozen solution that contained the fallout material with a density greater than 4.30. This retention was fortuitous and obviated handling and cutting the frozen liquid into two sections.

The tube was then reimmersed in liquid nitrogen to resolidify the material

remaining in the bottom. The tube was then inverted, and the inner walls rinsed with distilled water. The rinse water was allowed to run into the beaker containing the major portion of the sample.

After the two portions were thawed, they were filtered through Millipore filters and the recovered density fractions were gamma-counted.

2.8 NEUTRON-ACTIVATION ANALYSES

Samples sent to GA for neutron-activation analysis were all counted, weighed, and analyzed on the 400-channel TMC first. Representatives of every type of sample obtained or processed by Project 2.6a were included, as shown below.

1. TTR background soil.
2. Sieved fractions of DT BM-09.
3. Separated solid material from water and water-plus-clay leach samples.
4. Purified Pu^{239}.
5. Purified Am^{241}.
6. Mixture of 4 and 5 in same proportion as in device plutonium (see Table 2.5).
7. Mixture of 4 and 5 (as in 6) plus TTR soil.
8. Evaporated solution of 99.80 weight percent U^{238} and 0.20 weight percent U^{235} as a calibration standard (see Table 2.5).
9. Evaporated solution of Roller Coaster device plutonium.
10. Mixture of 8 and 9.
11. Roller Coaster plutonium mixed with TTR background soil.
12. Roller Coaster fallout samples or aliquots of samples from each event.

General Atomic was requested to analyze the above samples (as appropriate) for Am^{241}, Pu^{239}, U^{238}, and U^{235}. The general analytical procedure was outlined to GA who devised the specifics and performed the analyses. GA was furnished with order-of-magnitude estimates of the Pu^{239} content derived from NRDL counting data. This effected a saving of time and money by allowing irradiation times to be adjusted to yield samples whose activities were within a reasonable range.

Samples received by GA were first weighed and then counted directly on the 400-channel pulse-height analyzer to determine their Am^{241} content. The area

under the 60-kev photopeak of Am^{241} was compared with that of the known americium provided by NRDL. Several standards were prepared so that a mathematical correction for sample geometry was not required to obtain the Am^{241} content of fallout samples.[3]

The U^{238} and Pu^{239} content of samples was obtained by first irradiating fallout and background soil samples and standards of U^{238} and Pu^{239} in the pneumatic tube of TRIGA Mark I reactor for about 1 minute at a thermal neutron flux of 3.5×10^{12} $n/cm^2/sec$.

The U^{238} content of the sample was estimated by comparing the 105-kev photopeak of 2.3-day Np^{239} with that of the known U^{238} standard. Np^{239} is the daughter of 23.5-minute U^{239}, the activation product of U^{238}. From the amount of U^{238} present in the sample, the U^{235} present was calculated on the basis of the natural uranium present in the soil and from information supplied by NRDL on the isotopic content of the depletalloy used to fabricate the devices.

Following irradiation, the sample was allowed to decay approximately 2 weeks, then counted in a 3- by 3-inch well-type NaI crystal detector to determine the size of the 1.60-Mev La^{140} photopeak. From the calculated amount of U^{235} present and the known yield of La^{140} from 1-minute activations of U^{235} and Pu^{239} standards, the 1.60-Mev photopeak was resolved to give the quantity of Pu^{239} present in the sample.

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[3] The description of the analytical procedure was furnished by Mr. H. R. Lukens, General Atomic.

TABLE 2.1 WEATHER DATA AT SHOT TIMES

Event	Time	Date	Wind Speed at GZ	Wind Shear	Temperature Inversion
			(knots)	(degrees)	(°C)
Double Tracks	0255	15 May 1963	11	25	2.5 at 500 ft
Clean Slate I	0417	25 May 1963	12	almost none	5 at 600 ft
Clean Slate II	0347	31 May 1963	6	40	2 at 500 ft

TABLE 2.2 RESPONSE OF GAMMA COUNTER AT TTR TO NON-ROLLER COASTER PLUTONIUM STANDARD

	Response		
	DT	CS I	CS II
105 μg Pu^{239} (cpm per μg of Pu^{239})	900	886	944
Background (cpm)	1,020	1,060	1,050

TABLE 2.3 LEACHING TEST SCHEDULE FOR EACH COMBINATION OF LEACHING MEDIUM, TIME AND FALLOUT (+74-μ Material)

Medium	Number of Samples		
	One Day	One Week	One Month
10 ml water	2	1	1
10 ml water + 10 g clay	1	1	1
10 ml of 1% Orvus Solution[a]	1	1	1
10 ml of 0.1N HCl	1	1	1
10 ml of 0.1 N NaOH	1	1	1

(a) Orvus is an industrial version of Tide, manufactured by Proctor and Gamble.

TABLE 2.4 LEACHING TEST SCHEDULE FOR EACH COMBINATION OF LEACHING SOLUTION, TIME AND FALLOUT (-74-μ Material)

Liquid	Number of Samples	
	One Day	One Week
10 ml water	1	1
10 ml of 1% Orvus solution	1	1
10 ml of 0.1N HCl	1	1
10 ml of 0.1N NaOH	1	1

TABLE 2.5 ANALYTICAL[a] AND OTHER PERTINENT DATA ON ROLLER COASTER URANIUM AND PLUTONIUM SAMPLES

Isotopic Analysis of Plutonium Sample sent to NRDL (Batch Number 63-UK-103-RC)	Pu^{238}[b] (Wt %)		Am^{241}[c] (Wt %)		$Pu^{239-240}$[b][c] (Wt %)
	0.0040		0.0234		> 99
Chemical Analysis of Plutonium Sample sent to NRDL	Plutonium (g Pu/g of metal sample)				
	0.9883				
Mass Spectrometric Analysis of Plutonium sample sent to NRDL (atomic percent)	238	239	240	241	242
	0.00	97.35	2.42	0.13	0.00
Isotopic Analysis of Uranium	U^{234}[b] (Wt %)		U^{235}[c] (Wt %)		U^{238}[b] (Wt %)
	< 0.001		0.21		99
	< 0.001		0.22		99
Mass Spectrometric Analysis of Uranium (atomic percent)	U^{235}		U^{238}		
	0.17		99.83		
	0.15		99.85		

	Double Tracks	Clean Slate No. 1	Clean Slate No. 2
Ratio of Uranium to Plutonium (by weight)[d]			
Ratio of Pu^{239} to U^{235}	4.35	47.2	100.4
	24:1	11:1	5:1

(a) Analytical data obtained from Reference 10. Data declassified by message from Commander, Field Command, DASA, to Roller Coaster personnel, message No. 031612Z, dated 3 February 1963. Americium determination made on 1 May 1965.

(b) By alpha spectrometry.

(c) By gamma spectrometry.

(d) Unclassified uranium to plutonium weight ratios originally sent by Commander, Field Command, DASA, to Roller Coaster personnel, message No. 280003Z, dated 28 July 1964. These ratios, shown here, are modified somewhat from previous values and are quoted from a 19 January 1965 memo from H. E. Menker to the Roller Coaster Evaluation Team.

Figure 2.1 Project 2.6a analytical and sample processing facilities at TTR. (DASA-135-9-TTR-63)

Figure 2.2 Large area particulate fallout collectors (aluminum collectors) being retrieved. (DASA-135-19-TTR-63)

Figure 2.3 Fallout and petrolatum being rinsed from aluminum collector with xylene spray. (DASA-135-24-TTR-63)

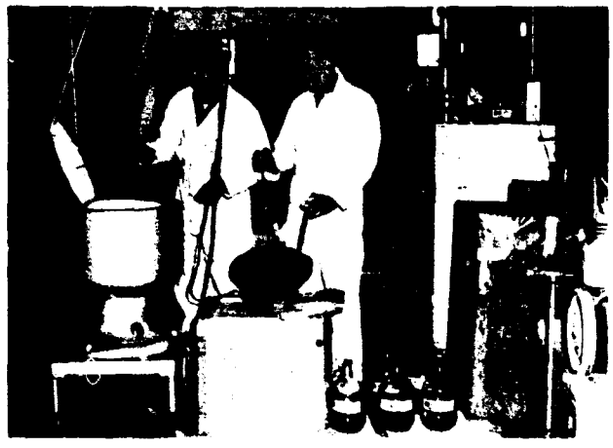


Figure 2.4 Inside sample processing facility. (DASA-135-18-TTR-63)

Figure 2.5 Forty-ml centrifuge tube enclosed in a 100-ml Lusteroid test tube showing 10 grams of fallout. (NRDL photo)

Figure 2.6 400-channel TMC pulse-height analyzer. (NRDL photo)

Figure 2.7 Ro-Tap sieve, shaker, and 3-inch-diameter sieves used in dry-sieve particle-size analyses. (NRDL photo)

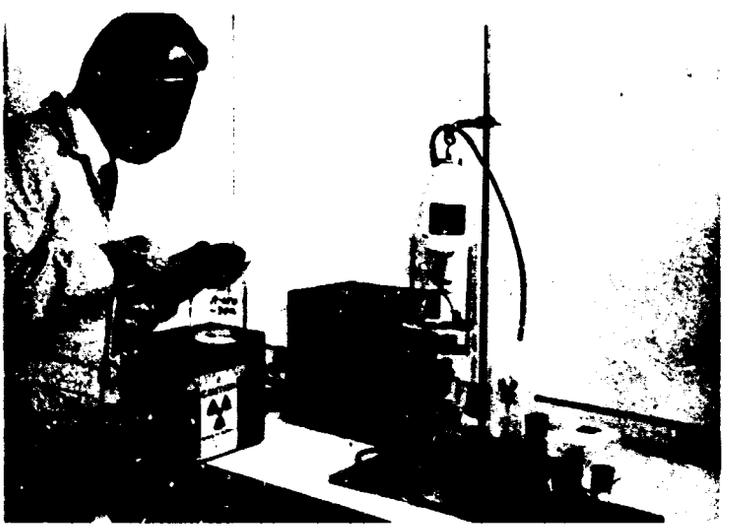


Figure 2.8 Sonic vibrator and ultrasonorator for wet-sieve particle-size analyses. (NRDL photo)

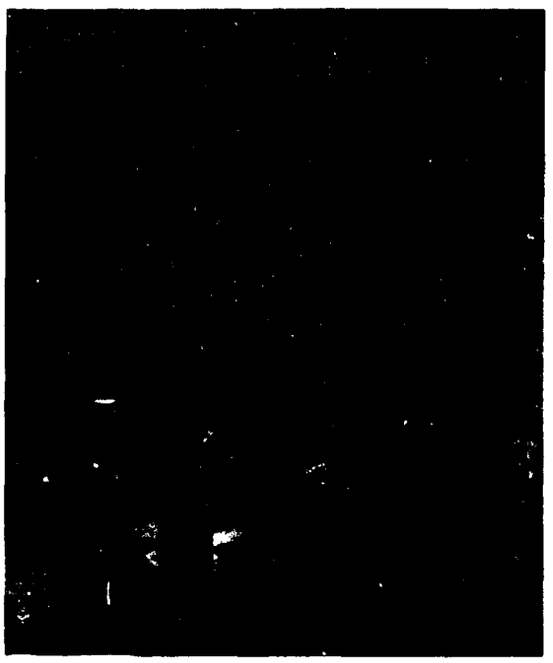


Figure 2.9 Separating fallout into density fractions. (NRDL photo)

Figure 2.10 Preparing station to receive fallout collectors. (DASA-135-13-TTR-63)

Figure 2.11 Station marker with blinker. (DASA-112-16-TTR-63)

Figure 2.12 Loading marked fallout collectors into transportation box aboard truck. (DASA-135-12-TTR-63)

Figure 2.13 Large area aluminum fallout collectors in transportation box on D−1. (DASA-139-21-TTR-63)

Figure 2.14 Measuring activity on fallout collector during recovery with an Eberline PAC 3G alpha survey instrument. (DASA-135-21-TTR-63)

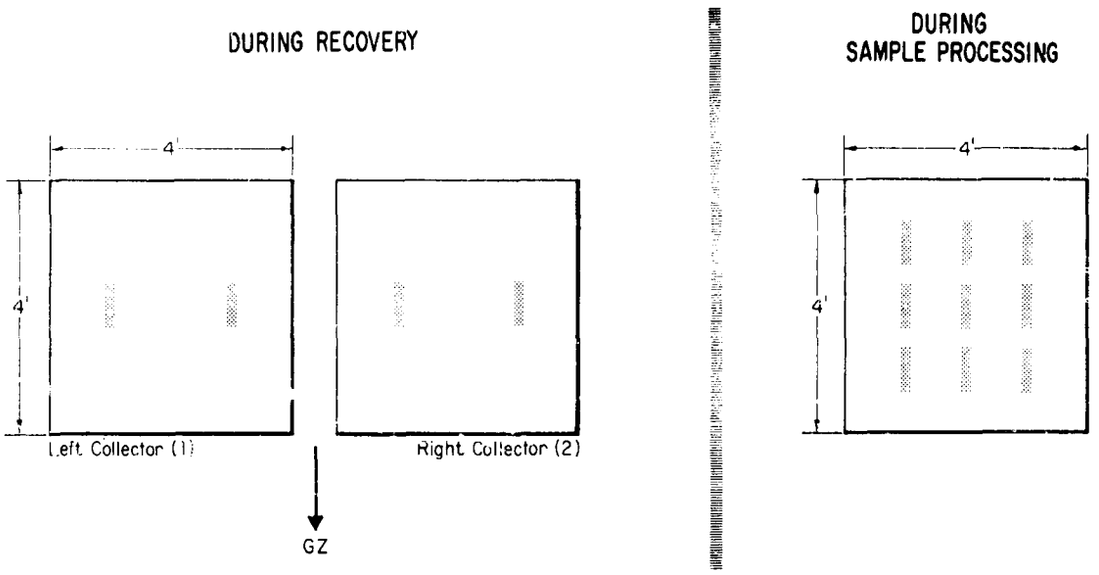


Figure 2.15 Alpha survey points on fallout collectors.

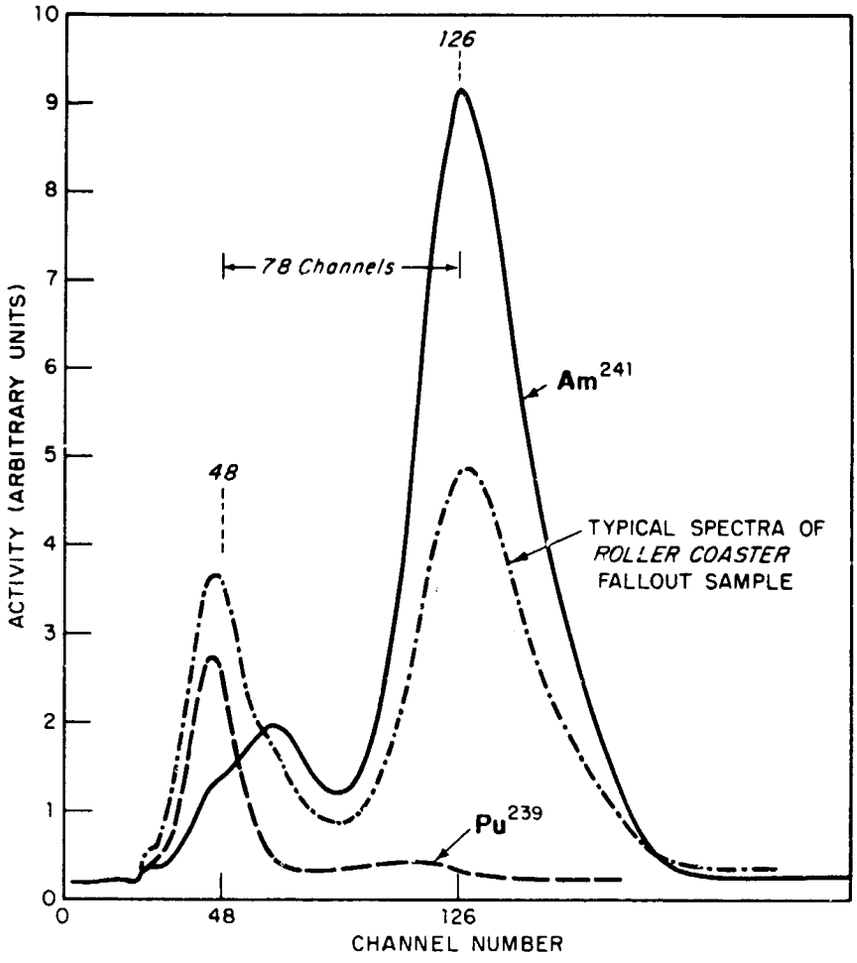


Figure 2.16 Typical gamma and X-ray spectra of purified Am^{241}, purified Pu^{239}, and Roller Coaster fallout.

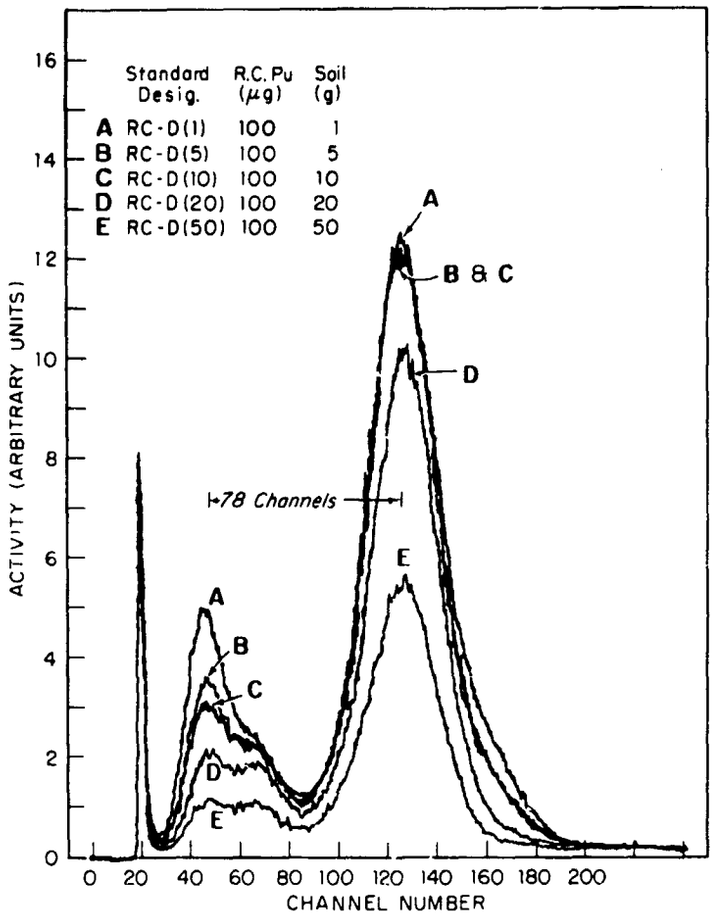


Figure 2.17 Gamma and X-ray spectra of Roller Coaster plutonium standards.

CHAPTER 3

RESULTS AND DISCUSSION

3.1 FALLOUT COLLECTOR ARRAY

The location and station numbers of the aluminum fallout collectors exposed by Project 2.6a are shown in Figures 3.1 through 3.3. Two 4-foot-square collectors were placed at each station except for the DT event where four collectors were placed at each station on "B", "C", and "D" arcs, which, respectively, were at 2,500-, 3,750-, and 5,000-feet downwind from ground zero.

3.2 ALPHA SURVEY OF ALUMINUM COLLECTORS

Every collector within the fallout area designated by Program 2 was monitored at two points. Those which exhibited at least 100 cpm alpha activity were recovered and are so indicated in Figures 3.1 through 3.3.

The alpha contamination isocontour lines, determined by Project 2.5 (Reference 3), are superimposed on the above figures and show that the locations of the Project 2.6a samples coincided with the fallout pattern.

The alpha monitoring data obtained by Project 2.6a for each pair of aluminum collectors are shown in Appendix C. These data can be combined with the reduced plutonium analytical data to help in solving the problem of correlating alpha instrument readings, in cpm, with the magnitude of a plutonium deposit, in $\mu g/m^2$. There is, however, no way to correlate alpha readings with the amount of deposited plutonium when the deposit is as deep as 2 inches (or more) as occurred on the near collectors at CS II. Here, some form of gamma counting is the only practical procedure for estimating the amount of plutonium present, and the gamma-counting method used by Project 2.6a (see Section 2.6.3) provided a fast and meaningful estimate of the amount of plutonium present.

Each collector was also monitored immediately before and after the fallout

was removed from it. These results are tabulated in Appendix C also and show that very little residual plutonium remained on the aluminum surface of the collectors, usually less than 400 cpm. Wiping the surface with a Kimwipe moistened with xylene did not decrease the residual readings.

3.3 MASS, GAMMA ACTIVITY, AND PLUTONIUM CONTENT OF FALLOUT SAMPLES

The mass of the sample collected at each station is shown in Appendix D and represents the weight of fallout plus that of inert desert sand blown onto the collector. It was estimated that as much as 20 grams of this background soil may have been mixed with the fallout at a station: hence, mass and mass distribution data may not be representative of fallout, per se. The plutonium content was calculated from the observed gamma activity for each sample, corrected for self-absorption and sample geometry. The mass-of-fallout-per-square-meter and the mass-of-plutonium-per-square-meter are also shown in Appendix D.

The counting data taken at TTR and presented in Reference 3 were not corrected for self-absorption or sample geometry. Furthermore, the conversion of cpm to μg of plutonium was made by comparing the count rate of a sample with the count rate of a sample of non-Roller Coaster plutonium that was not used in preparing the Roller Coaster devices. To obtain a better estimate of the plutonium present in each sample, the TTR counting data were first normalized to correspond to the operation of the counter at NRDL. This was done through factors obtained from data on samples and standards counted at TTR and at NRDL. Thus, TTR DT counting data were normalized by multiplying by 1.09, CS I data by 1.10, and CS II data by 1.05.

The effect of self-absorption and sample geometry on the gamma-counting rate of samples was determined from a series of standards, each a mixture of different amounts of background soil and RC plutonium. The counter response data for these standards are shown in Figure 3.4. The count rate of each fallout sample, normalized as explained above, was divided by the appropriate factor, cpm/μg of Pu^{239}, from Figure 3.4 to obtain its plutonium content. For samples

weighing less than 1 gram, the correction factor of 900 cpm/μg was used; for samples between 1 and 2 grams, 860 was used; for samples between 2 and 5 grams, 820 was used; and for samples between 5 and 10 grams, 780 was used. No samples over 10 grams were ever counted.

The lower limit of detection of this method was about 0.5-μg Pu^{239}.

The total plutonium and total mass for the near-in CS II stations can be obtained by adding the values for the (a) and (b) material. The (a) or nonadhering material was that which slid off the collector when tipped, and the (b) or adhering material is that which was retained by the petrolatum.

The 30-percent-greater specific activity of the (b) material for CS II BL-10 and the 100-percent-greater specific activity of the (b) material for CS II A-030 as seen in Table 3.9 may possibly be explained if it is assumed that the adhering (b) material, containing a greater percentage of plutonium, was more dense and was deposited on the collectors before the nonadhering (a) material.

3.4 GAMMA ACTIVITY IN XYLENE

The total activity leached by the xylene used to process the most active DT fallout samples was calculated from that in the evaporated residues of 100-ml aliquots. These data are tabulated in Table 3.1 and show that less than 1 percent of the activity of a sample was found in the xylene. It did not appear necessary to continue these checks for the other two events.

3.5 DISTRIBUTION OF MASS AND GAMMA ACTIVITY AMONG PARTICLE-SIZE FRACTIONS

The percents of mass and gamma activity associated with each particle-size fraction for the samples that were dry-sieved at TTR are shown in Appendix E. (The gamma counting data were not corrected by the factors given in Section 3.3.) Similar data for samples that were returned to NRDL and wet-sieved are shown in Appendix F. The cumulative percents of mass and gamma activity associated with particles less than each sieve size are tabulated and shown graphically in these appendixes also.

The data in Appendixes E and F are summarized in Tables 3.2 and 3.3, wherein the particle sizes for the 50th percentile of mass and activity are shown. (The data on mass of fallout is subject to some question, as explained in Section 2.5.1.) The data show that, for samples from corresponding arcs in different shots, the order of ascending particle size associated with the 50th percentile of activity among the three events was CS II, DT, and CS I. The data also show that there is a decrease in active particle size with increasing downwind distance. There does appear, however, to be an increase in active particle size for DT out to Grid BM, after which it decreases.

The distributions of mass and activity by wet and dry sieving for the same samples are almost identical. This was somewhat surprising since it is usually assumed that wet sieving is much more efficient for particles below 74μ in diameter. For RC fallout, however, this assumption did not hold.

Photomicrographs of the wet-sieved fractions of DT D-050 are shown in Appendix G. These were taken to determine the effectiveness of the wet-sieving procedure to separate particles into discrete ranges and show that separation was quite complete.

The plutonium and americium contents of particle-size fractions of DT BM-09, as determined by gamma spectral analyses (Appendix H) and plutonium and uranium content as determined by neutron activation (Appendix I) are given in Table 3.4. The Am/Pu ratio is constant, showing that no fractionation occurred, and that determining Pu^{239} by measuring the 60-kev Am^{241} photopeak activity is valid. The U^{238}/Pu^{239} ratio was not constant however, indicating that fractionation of these two isotopes among different particle sizes did occur. Consequently, in any contemplated use of U^{238} as a tracer for Pu^{239}, the possibility of fractionation with particle size must be recognized.

3.6 GAMMA AND X-RAY SPECTRAL ANALYSES

Pulse-height data for samples from each event appear in Appendix H. One photopeak reflects the activity of the 17-kev X-ray of Pu^{239}, and the other arises from the activity of the 60-kev gamma ray of the Am^{241} daughter of Pu^{241}. Am^{241}

was present in RC plutonium on 1 May 1963 to the extent of about 0.025 percent (see Table 2.5). The response curve of the pulse-height analyzer to RC standards is shown in Figure 3.5, wherein the observed activity of the 60-kev gamma photon of Am^{241} is related to the known Pu^{239} content of RC standards. (These were the same standards used to derive Figures 3.4 and 3.6.) This curve was then used to convert pulse-height data into plutonium content. As with the gross gamma method, the lower limit of detection of this method is about 0.5 μg of Pu^{239}.

The plutonium content of samples could not be derived directly from the activity observed in the 17-kev Pu^{239} X-ray photopeak under the conditions employed because this low energy X-ray was too greatly affected by small changes in the sample mass. If the 17-kev activity is to be used as a direct measure of Pu^{239}, it will be necessary to employ a different sample container and geometry.

Gamma spectral analyses for plutonium under the conditions used by Project 2.6a required that analyzed standards of the device material be available or that the Pu^{239} to Am^{241} ratio be known so that counting standards could be prepared. It also required that the Am^{241} and Pu^{239} not be fractionated either during or after the event. No evidence of fractionation was observed in the RC samples (see Table 3.4). The method, however, was faster and cheaper than neutron-activation or radiochemical analyses and provided results that were in reasonable agreement with the latter two methods (see Section 3.10). The total gamma counting method, although faster, was not quite as accurate as the spectrometric method because the discriminator of the gamma counter was adjusted to register the low energy 17-kev Pu^{239} X-ray. Raising the level of the discriminator to reject photon energies below 30 or 40 kev, thereby counting only the 60-kev Am^{241} gamma ray, will make the gamma counting method as accurate as gamma spectrometry.

The americium contents of samples were determined from the response to the Am^{241} 60-kev photopeak, as shown in Figure 3.6, and are reported in Appendix H. These values are comparable to those determined by GA, except that the

GA values inexplicably averaged 30.0 ± 8.6 percent higher than those obtained by NRDL on the same samples.

3.7 NEUTRON-ACTIVATION ANALYSES

The analytical results of the neutron-activation analyses of samples reported by GA appear in Appendix I. The results for known samples, in Table I.1, averaged 113 ± 14 percent of the known plutonium and 84 percent of the known uranium content. They show uranium to plutonium ratios consistent with those in the initial material (see Table 3.5).

The neutron-activation procedure requires that the contribution from the U^{235} FP to the total activity in an irradiated sample be known. The uranium content of a sample is obtained from the 2.3-day Np^{239} which results from the neutron capture by U^{238}. From a known, calculated, or experimentally derived ratio of U^{238}/U^{235}, the contribution of the activity from U^{235} FP to the total activity can then be calculated and subtracted to yield the activity due to Pu^{239} FP.

The analyses for Pu^{239} can be done for approximately $40 per sample and is nondestructive. It is entirely instrumental and eliminates errors incurred by chemical separation. It has the advantage of not requiring that the Pu/Am ratio be known or constant. The lower limit of detection is about 0.005 μg, which is lower by a factor of 100 than the gamma counting methods.

The data in Table I.2 show that neutron activation for uranium in uncontaminated background soil samples yielded results that fell within the range of 10 to 20 μg/g. It is obvious from the uranium and plutonium data in Tables I.2 and I.3 that the Pu^{239} to U^{235} ratio for any sample was less than 5 to 1. This is the ratio for the source material in CS II. The ratios for DT and CS I source material were 24 to 1 and 11 to 1, respectively (see Table 2.5). It is also obvious from the tables in Appendix I that natural uranium comprised less than 16 percent of the total uranium in any sample. These facts lead to the obvious conclusions that natural background uranium can, for all intents and purposes, be ignored and that less than 20 percent of the La^{140} observed in irradiated samples came from U^{235}, either natural or depleted. It is interesting to note, however, that

there was a considerable variation in the uranium content of different particle-size fractions.

3.8 SOLUBILITY AND ION EXCHANGE OF PLUTONIUM

The gamma counting results of solubility and ion-exchange studies are shown in Tables 3.6 and 3.7. Water, Orvus, and sodium hydroxide did not dissolve any appreciable amounts of plutonium from fallout, whether they were in contact for 1 day or 1 month. The 0.1 N hydrochloric acid, however, dissolved between 2 and 23 percent and the fraction dissolved was directly related to contact time. Furthermore, HCl surprisingly appeared to be more effective in dissolving plutonium from +74-μ particles than from −74-μ particles.

Approximately 6 percent of the activity transferred from +74-μ fallout to montmorillonite clay whether time of contact was 1 day, 1 week, or 1 month. One might logically assume that the activity in the clay resulted from very small active particles that were washed through the 250-mesh (63-μ) sieve with the clay when the clay was separated from the +74-μ fallout. The data from the 1-week water sample that was washed and treated as if it had contained clay showed that only 0.6 percent of the activity appeared in the wash water. It must be concluded, therefore, that the activity of the clay did not result from small plutonium-bearing particles being washed through the sieve with the clay but by some other mechanism.

It is unfortunate that no pulse-height analyses were made of the leach samples, particularly of HCl or clay leach samples, to ascertain if fractionation of Am^{241} and Pu^{239} occurred with the transfer of gamma activity to the clay or HCl solution. Neutron-activation analysis for uranium and plutonium in clay after separation from the +74-μ portion of the composite DT leach sample (Sample No. 104, Table I.3) showed that the uranium/plutonium ratio was 28.5. Comparing this to the DT ratio of about 4.4 (Table 2.5) indicates that uranium was preferentially absorbed by the clay. No other fractionation data on leach samples were obtained.

3.9 DISTRIBUTION OF ACTIVITY BETWEEN FALLOUT PARTICLES WITH DENSITY LESS THAN, AND GREATER THAN, 4.30

The relative activity in the two separated density fractions from one fallout sample from each event is shown in Table 3.8.

The DT AH-06 sample was sieved into +74-μ and −74-μ fractions, each of which contained approximately 50 percent of the activity of the sample. Twelve percent of the activity was associated with the more dense fraction of the +74-μ material, while 41 percent of the activity was found in the more dense fraction of the −74-μ material. Since the total activity of the sample was nearly evenly divided between the two size fractions, it was possible by simple arithmetic to derive that 27 percent of the activity was associated with the more dense material for the unsieved sample. This can be compared to 1 percent for CS I BM-06 and 23 percent for CS II B-030.

One might logically assume that a greater fraction of activity should be associated with the more dense portion of the DT and CS I samples than for the one from CS II. Low density desert soil over the CS II bunker could have acted as a scavenger for the high density plutonium oxide[4], whereas the DT and CS I explosions were relatively free of such low density material. This assumption is not borne out by the data which, unfortunately, were obtained from only one sample from each event.

In all cases the more dense fraction was black, contained less than 5 percent of the mass of the sample and, because of its magnetic properties, was assumed to contain a large proportion of magnetite, density 5.2, which is present in small amounts in the background (Nevada) soil.

3.10 ALIQUOTING DRY ROLLER COASTER SAMPLES

During the analytical phase of Operation Roller Coaster, concern was expressed by the Scientific Director, representatives of some of the Project 5.2/5.3 contractor laboratories, the Chairman of the Referee Team, and others,

[4] The density of quartz and feldspars is about 2.6 as compared to 11 for plutonium oxide.

that aliquots of a dry sample might not be representative of the sample as a whole.

Project 2.6a separated some fallout samples (from aluminum collectors) into aliquots with no effort being made to obtain representative aliquots; these separations were made for the sole purpose of dividing samples into convenient sized portion.

The counting data from these aliquots are shown in Appendix K and are summarized in Table 3.9. The data indicate that the activities of the aliquots were similar to each other. From this it can be inferred that the aliquots were representative of the entire sample.

Inspection of the analytical data in Tables 3.10.2 and 3.10.3 shows similar agreement among the results for aliquots that were analyzed by several methods.

3.11 COLLATION OF ANALYTICAL DATA

Comparisons of results of plutonium analyses performed by different methods are shown in Tables 3.10.1, 3.10.2, and 3.10.3 and are summarized in Table 3.11. The following ratios between analyses of comparable or identical samples were calculated from all available results:

$$\text{Ratio I} = \frac{\text{Gamma Spectrometry Results}}{\text{Gamma Counting Results}}$$

$$\text{Ratio II} = \frac{\text{Neutron Activation Results}}{\text{Gamma Counting Results}}$$

$$\text{Ratio III} = \frac{\text{Radiochemical Results}}{\text{Gamma Counting Results}}$$

$$\text{Ratio IV} = \frac{\text{Neutron Activation Results}}{\text{Gamma Spectrometry Results}}$$

$$\text{Ratio V} = \frac{\text{Radiochemical Results}}{\text{Gamma Spectrometry Results}}$$

The averages of these ratios were calculated from all available results and are shown in Table 3.11. These averages also included data from a set of samples that were distributed specifically for the purpose of obtaining correlated gamma counting, gamma spectrometric, and radiochemical analytical data.

intercomparisons of the data for the special samples, shown in Table 3.11, were very close to those for all samples.

The following obtains for the data compiled for all samples. Ratio I indicates that gamma spectrometry yielded plutonium results that averaged about 13 ± 10 percent higher than those from gross gamma counting. Ratio II seems to indicate that neutron activation produced results that averaged 20 ± 14 percent higher than gamma counting. Ratio III indicates that the average results of radiochemical analyses were identical with those from gamma counting. Neutron activation and gamma spectrometric methods yielded results that were quite close as shown by Ratio IV, 104 ± 8 percent. The comparison that is reflected by Ratio V shows that gamma spectrometric results were 84 ± 7 percent of the radiochemical results.

It is interesting to note that the gamma spectrometric determinations of plutonium by H-NSC were very close, 102 ± 15 percent of the results obtained by gross gamma counting done by Project 2.6a for four samples. A similar comparison of spectrometric results obtained by EIC for ten samples was 91 ± 10 percent.

There is not a single sample from which a comparison between neutron activation and radiochemical results can be obtained. However, it can be inferred that, from a comparison of Ratios II and III in Table 3.11, neutron-activation results would be 20 percent higher than radiochemical results.

The data in this section point out the fact that all analytical methods yielded similar results and that, with some modifications in the calibration and correction factors used in the nonchemical instrumental methods, these methods can easily duplicate the radiochemical results.

TABLE 3.1 GAMMA ACTIVITY IN XYLENE USED IN PROCESSING DOUBLE TRACKS FALLOUT SAMPLES

Sample Number	Total Activity in Fallout (cpm $\times 10^{-5}$)	Total Activity in Xylene (cpm $\times 10^{-3}$)	Fraction of Activity of Fallout in Xylene (percent)
AH-06	17	6.3	0.27
AJ-07	27	6.2	0.23
BK-09	1.8	1.7	0.94
BL-09	5.2	4.2	0.79
BM-09	9.6	6.7	0.70
A-070	7.6	5.7	0.75
B-070	2.4	2.0	0.83
C-060	1.4	1.1	0.78
D-050	3.0	2.2	0.73

TABLE 3.2 SUMMARY OF DRY-SIEVE PARTICLE-SIZE ANALYSES

Event	Sample Number	Particle Size of 50th Percentile	
		by Mass (μ)	by Activity
DT	AH-06	95	95
	AH-07	80	100
	AJ-07	45	215
	BK-09	46	290
	BL-09	70	250
	BM-09	50	200
	A-070	56	110
	B-070	62	65
	C-060	58	75
	C-070	47	<44
	D-050	66	90
	D-060	50	65
	D-070	52	44
CS I	AH-06	52	720
	AJ-06	130	580
	BK-08	96	330
	BL-07	68	340
	BM-06	440	480
	BO-06	68	220
	A-030	220	220
	B-030	68	230
	C-030	<44	220
	D-030	<44	210
	F-030	76	175
	H-030	130	110
CS II	AJ-08	100	67
	BK-10(a)	94	60
	BL-10(a)	78	43
	BM-05(a)	<44	<44
	BO-04(a)	220	145
	A-030(a)	120	110
	B-030	51	46
	C-030	48	<44
	D-030	44	<44
	F-030	<44	<44
	H-030	<44	<44

TABLE 3.3 SUMMARY OF WET-SIEVE PARTICLE-SIZE ANALYSES

Event	Sample Number	Particle Size of 50th Percentile	
		by Mass (μ)	by Activity
DT	AJ-07	49	145
	BM-09	48	145
	A-070	59	140
	D-050	80	87
CS I	BL-07	66	320
	B-030	68	220
	D-030	47	200
	H-030	110	125
CS II	BL-10(a)	72	44
	A-030(a)	105	100
	D-030(a)	32	39
	H-030	<44	<44

TABLE 3.4 WEIGHT RATIOS OF Am^{241} TO Pu^{239} AND U^{238} TO Pu^{239} FOR PARTICLE-SIZE FRACTIONS OF DOUBLE TRACKS SAMPLE BM-09

Event	Station Number	Particle Size Fraction (μ)	Am^{241}/Pu^{239}	U^{238}/Pu^{239}
			(April 1964)	
DT	BM-09	+210	1.87×10^{-4}	2.31
DT	BM-09	+105	1.92×10^{-4}	4.19
DT	BM-09	+ 44	1.89×10^{-4}	38.0
DT	BM-09	+ 30	1.92×10^{-4}	16.1
DT	BM-09	+ 10	1.97×10^{-4}	5.82
DT	BM-09	- 10	1.95×10^{-4}	3.02
Average			$1.92 \pm 0.04 \times 10^{-4}$	11.5 ± 13.9

Am^{241} determined spectrometrically at NRDL.
Pu^{239} determined by neutron activation analysis.
U^{238} determined by neutron activation analysis.

TABLE 3.5 WEIGHT RATIOS OF U^{238} TO Pu^{239} IN FALLOUT SAMPLES AND PLUTONIUM STANDARDS (FROM NEUTRON ACTIVATION) (a)

GA Sample Number	Event	Station Number	U^{238}/Pu^{239}	Average Ratio	Nominal Ratio in Initial Material (b)
211	DT	B-070	5.34		
212	DT	C-070	5.47		
				5.40	4.35
213	CS I	BO-06	31.8		
214	CS I	C-030	45.2		
				38.5	47.2
210	CS II	B-030	86.3		
209	CS II	C-030	90.7		
217	CS II	F-030	82.1		
				86.4	100.4

(a) From Appendix I. (b) See footnotes for Table 2.5.

TABLE 3.6 GAMMA COUNTING RESULTS OF +74-μ DOUBLE TRACKS LEACH SAMPLES

Leach Media	Initial Activity On Soil (cpm)	Activity On Soil After Leach (cpm)	% On Soil	Activity In Liquid After Leach (cpm)	% In Liquid	Activity In Clay After Leach (cpm)	% In Clay
1 Day							
H_2O	115,300	114,400	99.2	233	0.20		
H_2O + Clay	163,700	151,300	92.4	248	0.15	10,338	6.32
1% Orvus	142,400	140,700	98.8	115	0.08		
0.1N HCl	158,200	148,400	93.8	8,537	5.4		
0.1N Na OH	119,500	119,100	99.7	- 3	0.0		
1 Week							
H_2O	138,800	137,600	99.1	113	0.08		
H_2O*	124,100	122,900	99.0	704	0.57		
H_2O + Clay	137,300	127,700	93.0	682	0.50	8,548	6.23
1% Orvus	122,100	119,800	98.1	191	0.56		
0.1N HCl	148,100	127,200	85.9	18,190	12.3		
0.1N Na OH	124,900	120,240	96.3	99	0.08		
1 Month							
H_2O	109,100	109,100	100.0	32	0.03		
H_2O + Clay	156,300	146,100	93.5	73	0.05	8,050	5.5
1% Orvus	166,400	164,600	98.9	323	0.19		
0.1N HCl	162,200	126,300	77.9	38,000	23.4		
0.1N Na OH	134,700	134,000	99.5	134	0.10		

*Sieved and processed as H_2O + Clay.

TABLE 3.7 GAMMA COUNTING RESULTS OF
−74-μ DOUBLE TRACKS LEACH SAMPLES

Leach Media	Initial Activity On Soil (cpm)	Activity On Soil After Leach (cpm)	% On Soil	Activity In Liquid After Leach (cpm)	% in Liquid
1 Day					
H_2O	89,700	89,340	99.6	131	0.15
1% Orvus	87,960	87,810	99.8	196	0.22
0.1N HCl	86,820	85,270	98.2	1475	1.70
0.1N NaOH	89,790	87,680	97.7	487	0.54
1 Week					
H_2O	92,700	90,820	98.0	280	0.30
1% Orvus	90,540	89,510	98.9	228	0.25
0.1N HCl	90,700	86,020	94.8	2990	3.20
0.1N NaOH	89,680	89,070	99.3	187	0.21

TABLE 3.6 DISTRIBUTION OF GAMMA ACTIVITY BETWEEN FALLOUT PARTICLES WITH DENSITY LESS THAN, AND GREATER THAN, 4.30

Event	Station No.	Sample No.	Sample Weight (Grams)	Initial Activity (cpm)	Activity of Portion With Density Greater Than 4.30 (cpm)	Fraction of Activity in More Dense Portion (Percent)	Activity of Portion With Density Less Than 4.30 (cpm)	Fraction of Activity in Less Dense Portion (Percent)
DT	AH-06	+74 μ (4)	0.5	55,500	10,200	18.4	45,800	82.5
	AH-06	+74 μ (5)	0.5	62,000	3,200	5.2	60,000	96.8
	AH-06	+74 μ (6)	0.5	76,400	10,400	13.6	65,200	85.2
AVERAGE						12.4		88.2
DT	AH-06	-74 μ (1)	0.5	43,400	22,800	52.6	20,200	46.6
	AH-06	-74 μ (2)	0.5	45,100	14,600	32.1	30,500	67.0
	AH-06	-74 μ (3)	0.5	47,100	17,800	37.9	28,100	59.7
AVERAGE						40.9		57.8
AVERAGE OF TWO SIZE FRACTIONS						26.7		73.0
CS I	BM-06	1	0.5	159,000	1,100	0.7	160,900	100.9
	BM-06	2	0.5	164,500	3,300	2.0	159,000	96.6
	BM-06	3	0.5	179,500	950	0.5	176,100	98.1
AVERAGE						1.1		98.5
CS II	B-030	7	1.0	14,600	2,060	14.1	12,700	87.1
	B-030	8	1.0	18,600	5,600	30.4	13,300	71.6
	B-030	10	1.0	19,800	4,700	23.6	14,700	73.8
AVERAGE						22.7		77.5

Note: In no case did the separated Clerici solution and wash water exhibit any activity over background.

TABLE 3.9 SUMMARY OF GAMMA ACTIVITY IN ALIQUOTS OF DRY SAMPLES

Event	Sample Number	Number of Aliquots	Average Specific Activity in Aliquots ± Standard Deviation (10^2 cpm/g)(1)
DT	plus 74-μ leach samples(2)	16	1334 ± 174 (13%)
DT	minus 74-μ leach samples(2)	8	897 ± 18 (2.0%)
CS I	AH-06	5	745 ± 54 (7.2%)
CS II	BL-10(a)	46	43.7 ± 0.7 (1.6%)
CS II	BL-10(b)	11	58.8 ± 0.5 (0.9%)
CS II	A-030(a)	14	88.5 ± 1.6 (1.8%)
CS II	A-030(b)	7	173 ± 3.7 (2.1%)

(1) Summarized from Table K.1

(2) Mixture of AH-06, AH-07, BK-09 and BL-09

TABLE 3.10.1 COLLATION OF PLUTONIUM ANALYTICAL RESULTS, DOUBLE TRACKS

Sample Number	Particle Size[6]	Weight	Specific Plutonium Content, μg Pu/g of Sample				Ratios[5]				
			by Gamma Counting[1]	by Gamma Spectrometry[2]	By Neutron Activation[3]	By Radio-chemistry[4]	I	II	III	IV	V
	μ	g									
AH-05		12.5	23	–	—	17			0.74		
AH-06		19.5	120	—	—	—					
AH-06		1.000	—	—	—	90			0.75		
AJ-04		4.52	2.9	—	—	0.6[8]			(0.20)		
AJ-05		4.58	7.4	—	—	2.4[8]			(0.32)		
AJ-06		6.00	56	—	—	9.4[8]			(0.17)		
AJ-07		4.50	738	—	—	—					
AJ-07		1.0000	—	—	—	888					
AJ-07		3.50	—	872	—	—	1.18		1.20		1.02
AJ-08		3.05	20.4	—	—	2.8[8]			(0.14)		
BK-07		3.95	1.5	—	—	1.8			1.20		
BK-08		3.02	5.0	—	—	5.3			1.06		
BL-07		2.45	1.6	—	—	2.2			1.38		
BL-08		2.25	11.5	—	—	15			1.30		
BL-09		3.58	185	—	—	—					
BL-09		1.0000	—	—	—	204			1.10		
BM-08		2.40	5.8	—	—	3.7[8]			(0.64)		
BM-09		3.32	358	513	—	—	1.43				
BM-09	+ 350	0.0461	1,480	1,353	—	—	0.91				
BM-09	+ 210	0.1510	3,190	3,900	4,580	—	1.22	1.44		1.17	
BM-09	+ 149	0.0471	4,260	4,698	—	—	1.10				
BM-09	+ 105	0.1237	1,860	2,099	2,480	—	1.13	1.33		1.18	
BM-09	+ 74	0.4617	460	520	—	—	1.13				
BM-09	+ 44	0.8871	128	147	149	—	1.15	1.16		1.01	
BM-09	−44[9]	1.3427	172	190	—	—	1.10				
BM-09	+ 40	0.2[illegible]8	90	115	—	—	1.28				
BM-09	+ 30	0.2699	125	127	127	—	1.02	1.02		1.00	
BM-09	+ 20	0.3195	135	142	—	—	1.05				
BM-09	+ 10	0.2229	198	205	213	—	1.04	1.08		1.04	
BM-09	−10	0.2201	344	361	358	—	1.05	1.04		0.99	

TABLE 3.10.1 CONTINUED

Sample Number	Particle Size [6]	Weight	Specific Plutonium Content, μg Pu/g of Sample				Ratios [5]				
			by Gamma Counting [1]	by Gamma Spectrometry [2]	by Neutron Activation [3]	by Radio-chemistry [4]	I	II	III	IV	V
	μ	g									
BO-10		1.45	47	—	—	0.5 [8]			(0.11)		
A-060		1.05	18	—	—	7.7 [8]			(0.43)		
A-070		1.30	774	—	—	—					
A-070		0.1000	—	—	—	799			1.03		
A-070		0.93	1,195	1,330	—	—	1.11		(0.67)		
A-080		0.81	1.8	—	—	1.7			1.00		
B-060		2.83	16.7	—	—	6.1 [8]			(0.37)		
B-070		3.36	86.7	—	120	—		1.38			
C-050		3.52	15.8	—	—	18			1.14		
C-060		4.8	36.1	—	—	—					
C-060		4.61	40	53	—	45	1.32				
C-060		0.1000	—	—	—	38			1.09 [10]		
C-070		3.85	18.8	—	26	—		1.38			
D-050		1.52	240	—	—	—					
D-050		0.1000	—	—	—	582 [8]			(2.42)		
D-050	+149	0.0930	650	681	—	—	1.05				
D-050	+105	0.0526	132	140	—	—					
D-050	+74	0.0818	115	123	—	—	1.06				
D-050	+44	0.1818	445	517	—	—					
D-050	−44	0.4337	173	193	—	—	1.11				
D-060		2.33	61	(62)	—	—	(1.01)				
D-070		1.07	42.9	—	—	5.3 [8]			(0.12)		
GA 104 (clay from leach)	−44	1.0	95	—	100	—		1.05			

For footnotes see end of Table 3.10.3.

TABLE 3.10.2 COLLATION OF PLUTONIUM ANALYTICAL RESULTS, CLEAN SLATE I

Sample Number	Particle Size [6]	Weight	Specific Plutonium Content, μg Pu/g of Sample				Ratios [5]				
			by Gamma Counting [1]	by Gamma Spectrometry [2]	by Neutron Activation [3]	by Radio-chemistry [4]	I	II	III	IV	V
	μ	g									
AH-06		46.89	818	—	—	—					
AH-06		2.00	—	—	—	4.8 [8]			(0.06)		
AH-06	(Aliq. 2)	10.00	92	134	—	—	1.46				
AH-06	(Aliq. 4)	7.274	89	117	—	—	1.31				
AH-06	(Aliq. 5)	6.648	105	119	—	—	1.13				
BK-05 [11]		10.58	1.7	—	—	1.2			0.71		
BK-06		12.42	28.2	—	—	23.2			0.82		
BK-08		21.46	160	(203)	—	—	(1.27)				
BK-09		27.45	11.3	—	—	9.7			0.86		
BL-05		7.05	3.4	—	—	1.01 [8]			(0.30)		
BL-06		8.03	136	—	—	2.6 [8]			(0.19)		
BL-07		11.192	241	285	—	21.1 [8]	1.18		(0.09)		
BL-07	+ 710	0.2421	228	256	—	—	1.10				
BL-07	+ 350	1.7807	756	808		—	1.07				
BL-07	+ 210	1.2407	833	945		—	1.13				
BL-07	+ 149	0.1551	89	104	—	—	1.17				
BL-07	+ 105	0.3167	464	538	—	—	1.16				
BL-07	- 74	0.9585	84	100	—	—	1.19				
BL-07	+ 44	1.8509	31	34	—	—	1.10				
BL-08		6.02	250	—	—	64.1 [8]			(0.26)		
BL-09		6.60	26	—	—	7.9 [8]			(0.30)		
BM-05		3.00	86	102	—	—			1.19		
BM-07		4.28	194	—	—	253			1.30		
BM-09		6.42	6.9	—	—	6.6			0.96		
BO-04		2.69	146	—	—	166			1.14		
BO-06		2.7738	306	—	—	—					
BO-06		2.53	353	—	425	—		1.23			
BO-06		0.1000	390	418	—	[7]	1.07				
BO-08		3.20	17	—	—	—					
BO-08		3.1	—	—	—	17	1.00				

TABLE 3.10.2 CONTINUED

Sample Number	Particle Size[6]	Weight	Specific Plutonium Content, μg Pu/g of Sample				Ratios[5]				
			by Gamma Counting[1]	by Gamma Spectrometry[2]	by Neutron Activation[3]	by Radio-chemistry[4]	I	II	III	IV	V
	μ	g									
A-020		1.15	501	—	—	592			1.18		
A-040		0.7213	116	—	—	96.3			0.84		
A-050		0.7331	23	—	—	18.3			0.79		
A-060		0.8284	8.9	—	—	6.5			0.73		
B-020		1.1462	169	—	—	[7]					
B-030		1.2478	240	279	—	—	1.16				
B-030		0.1000	—	—	—	[7]					
B-040		1.7661	16.5	—	—	1.9[8]			(0.12)		
B-050		1.7669	5	—	—	[7]					
C-020		3.6	25	(25)	—	—	(1.00)				
C-030		—	97	—	123	—		1.27			
D-030		2.6894	155	140	—	—	0.90				
D-030		0.1000	—	—	—	[7]					
D-030	+350	0.0736	368	391	—	—	1.06				
D-030	+210	0.1812	730	812	—	—	1.11				
D-030	+149	0.0413	390	941	—	—	1.06				
D-030	+105	0.1066	390	425	—	—	1.09				
D-030	+74	0.2552	205	223	—	—	1.04				
D-030	+44	0.4498	37	40	—	—	1.08				
D-030	−44	0.1307	17	18	—	—	1.06				
F-030		1.8279	187	—	—	—					
F-030		1.68	221	268	—	219	1.21		0.99		0.82
H-030		2.2004	160	165	—	—	1.16				
H-030		0.1000	—	—	—	18[8]			(0.11)		(0.10)

For footnotes see end of Table 3.10.3.

TABLE 3.10.3 COLLATION OF PLUTONIUM ANALYTICAL RESULTS, CLEAN SLATE II

Sample Number	Particle Size [6]	Weight	Specific Plutonium Content, μg Pu/g of Sample				Ratios [5]				
			by Gamma Counting [1]	by Gamma Spectrometry [2]	by Neutron Activation [3]	by Radio-chemistry [4]	I	II	III	IV	V
	μ	g									
AJ-08(a)		10.10	4.4	4.1	—	—	0.93				
BL-10(a)		10.00	5.1	—	—	—					
BL-10(a)		8.16	—	5.5	—	—					
BL-10(a)		1.0000	—	—	—	4.9	1.08		0.96		0.89
BL-10(a)	(Aliq. 2)	10.00	5.8	6.7 (6.9)	—	5.4	1.16		0.93		0.80
BL-10(a)	(Aliq. 10)	10.00	5.7	6.5 (5.2)	—	5.2	1.14		0.91		0.80
BL-10(a)	(Aliq. 20)	10.00	5.6	6.6 (5.1)	—	5.1	1.18		0.91		0.77
BL-10(a)	(Aliq. 30)	10.00	5.6	6.5 (5.0)	—	5.3	1.16		0.99		0.82
BL-10(a)	(Aliq. 40)	10.00	5.5	6.4 (5.0)	—	5.3	1.16		0.96		0.83
BL-10(a)	(Aliq. 42)	10.00	5.7	6.6 (5.1)	—	5.2	1.16		0.91		0.79
BL-10(a)	+105	1.04	4.2	4.5	—	—	1.07				
BL-10(a)	+74	1.65	3.5	3.8	—	—	1.08				
BL-10(a)	+44	1.76	6.9	7.4	—	—	1.07				
BL-10(a)	−44	1.86	11	11	—	—	1.00				
BL-10(b)		113	7.4	—	—	—					
BL-10(b)	(Aliq. 1)	10.00	7.4	8.7 (6.7)	—	6.8	1.18		0.92		0.78
BL-10(b)	(Aliq. 5)	10.00	7.5	8.7 (6.3)	—	6.9	1.16		0.92		0.79
BL-10(b)	(Aliq. 7)	10.00	7.6	8.9 (6.2)	—	7.1	1.17		0.93		0.80
BL-10(b)	(Aliq. 9)	10.00	7.6	8.9 (6.5)	—	7.1	1.17		0.93		0.80
BO-04(a)		9.2	8.4	12	—	—	1.43				
BO-04(a)		1.0000	—	—	—	12.0			1.43		1.00
A-030(a)		8.52	10	12	—	—	1.20				
A-030(a)	(Aliq. 2)	10.00	12	13 (10.5)	—	—	1.08				
A-030(a)	(Aliq. 6)	10.00	11	13	—	—	1.18				
A-030(a)	(Aliq. 10)	10.00	11	13	—	—	1.18				
A-030(a)	(Aliq. 12)	10.00	11	13	—	—	1.18				
A-030(b)		9.8	21	—	—	—					
A-030(b)	(Aliq. 1)	10.00	22	27	—	—	1.23				
A-030(b)	(Aliq. 3)	10.00	22	27	—	—	1.23				
A-030(b)	(Aliq. 5)	10.00	22	28	—	—	1.27				
B-030		59.45	21	—	26	—		1.24		1.00	
B-030		1.0000	—	—	—	23			1.10		0.89
B-030		10.00	—	26	—	—	1.24				

TABLE 3.10.3 CONTINUED

Sample Number	Particle Size [5]	Weight	Specific Plutonium Content, μg Pu/g of Sample				Ratios [5]				
			by Gamma Counting [1]	by Gamma Spectrometry [2]	by Neutron Activation [3]	by Radio-chemistry [4]	I	II	III	IV	V
	μ	g									
B-040		27.9	14	—	—	18			1.28		
B-050		16.05	16	—	—	19			1.19		
B-070		5.7095	16	(15)	—	15	(0.94)		0.94		
B-080		3.79	9.7	—	—	9.7			1.00		
B-090		4.374	5.7	—	—	4.9			0.86		
C-030		15.136	26	—	—	—					
C-030		1.0000	—	—	—	24			0.92		
C-030		14.0214	—	30	29	—	1.15	1.12		0.97	
C-040		9.2329	21	—	—	21			1.00		
C-050		7.3642	18	—	—	17			0.94		
C-070		6.7352	7.9	—	—	7.2			0.92		
C-080		6.6960	5.1	—	—	4.1 [8]			(0.82)		
C-090		4.3312	4.7	—	—	3.8 [8]			(0.81)		
D-030		8.52	26	28	—	—	1.08				
D-030	+44	4.00	26	29	—	—	1.12				
D-030	−44	3.35	33	34	—	—	1.03				
D-040		4.0031	22	—	—	24			1.00		
D-050		2.7217	23	—	—	20			0.87		
D-070		1.5510	18	—	—	12 [8]			(0.67)		
D-080		1.6076	24	—	—	10 [8]			(0.42)		
D-090		1.5529	12	—	—	8.5 [8]			(0.71)		
F-030		9.3694	21	—	—	—					
F-030		8.3986	19	—	—	—					
F-030		8.15	—	—	22	—		1.10 [10]	0.90 [10]		
F-030		1.0000	—	—	—	18					
F-040		8.9788	8.9	—	—	6.6			0.74		
F-050		1.2090	13	—	—	8.8 [8]			(0.68)		

TABLE 3.10.3 CONTINUED

Sample Number	Particle Size [6]	Weight	Specific Plutonium Content, μg Pu/g of Sample				Ratios [5]				
			by Gamma Counting [1]	by Gamma Spectrometry [2]	by Neutron Activation [3]	by Radio-chemistry [4]	I	II	III	IV	V
	μ	g									
F-060		1.0032	14	—	—	7.0 [8]			(0.50)		
F-080		2.0189	6.0	—	—	2.0 [8]			(0.33)		
F-090		0.8818	10	—	—	15 [8]			(1.50)		
H-030		2.8908	14	14	—	—	1.00				
H-040		3.3842	9.2	--	—	7.8 [8]			(0.85)		
H-050		2.0768	19	—	—	15.0 [8]			(0.79)		
H-070		2.1698	7.8	—	—	4.6 [8]			(0.59)		
H-080		3.0755	4.2	—	—	3.2 [8]			(0.76)		
H-090		3.1440	4.8	(2.9)	—	2.8 [8]			(0.58)		

[1] From Appendix D.

[2] From Appendix H; values in parentheses were determined by EIC or H-NSC (see Appendix J) and were not used to calculate average ratios.

[3] From Appendix I.

[4] From Appendix J.

[5] $\text{Ratio I} = \frac{\text{Gamma Spectrometry Results}}{\text{Gamma Counting Results}}$ $\text{Ratio II} = \frac{\text{Neutron Activation Results}}{\text{Gamma Counting Results}}$ $\text{Ratio III} = \frac{\text{Radiochemical Results}}{\text{Gamma Counting Results}}$

$\text{Ratio IV} = \frac{\text{Neutron Activation Results}}{\text{Gamma Spectrometry Results}}$ $\text{Ratio V} = \frac{\text{Radiochemical Results}}{\text{Gamma Spectrometry Results}}$ (NRDL)

Ratios in parentheses were not used to compute average ratios in Table 3.11.

[6] The sample was analyzed before, or without, sieving unless a sieve size is specified.

[7] Radiochemical data were not available on 23 November 1964.

[8] These radiochemical results are subject to reevaluation and were not used to compute average ratios in Table 3.11, private communication, H. E. Menker, H-NSC, Roller Coaster Evaluation Team.

[9] Results are reported for the −44-μ sieve fraction before it was subsieved.

[10] When two or more comparable results exist, the ratio was calculated from the average of the values.

[11] CS I BK-05 has been erroneously reported previously as CS I BK-10.

TABLE 3.11 AVERAGE RATIOS FOR COMPARABLE PLUTONIUM ANALYSES

Ratio Number [a]	Average Ratios ± Standard Deviation [b]	Number of Samples	Average Ratios for Special Set of Samples [c] ± Standard Deviation	Number of Samples
I	1.13 ± 0.10	74	1.15 ± 0.10	18
I [d]	1.02 ± 0.15	5		
I [e]	0.91 ± 0.10	10		
II	1.20 ± 0.14	14	1.23	1
III	1.00 ± 0.17	50	0.95 ± 0.05	13
IV	1.04 ± 0.08	8	No data	
V	0.84 ± 0.07	15	0.81 ± 0.03	11

(a)

$$\text{Ratio I} = \frac{\text{Gamma Spectrometry Results}}{\text{Gamma Counting Results}}$$

$$\text{Ratio II} = \frac{\text{Neutron Activation Results}}{\text{Gamma Counting Results}}$$

$$\text{Ratio III} = \frac{\text{Radiochemical Results}}{\text{Gamma Counting Results}}$$

$$\text{Ratio IV} = \frac{\text{Neutron Activation Results}}{\text{Gamma Spectrometry Results}}$$

$$\text{Ratio V} = \frac{\text{Radiochemical Results}}{\text{Gamma Spectrometry Results}}$$

(b) Includes data from special samples.

(c) DT: BL-09 and C-060. CS I: AH-06 and BO-06. CS II: BL-10(a), BL-10(b), A-030(a), and A-030(b).

(d) Gamma spectrometry done by H-NSC on DT: D-060; CS I: BK-08 and C-020; and CS II: A-030 and B-070.

(e) Gamma spectrometry done by EIC on 6 aliquots of CS II BL-10(a) and 4 aliquots of CS II BL-10(b).

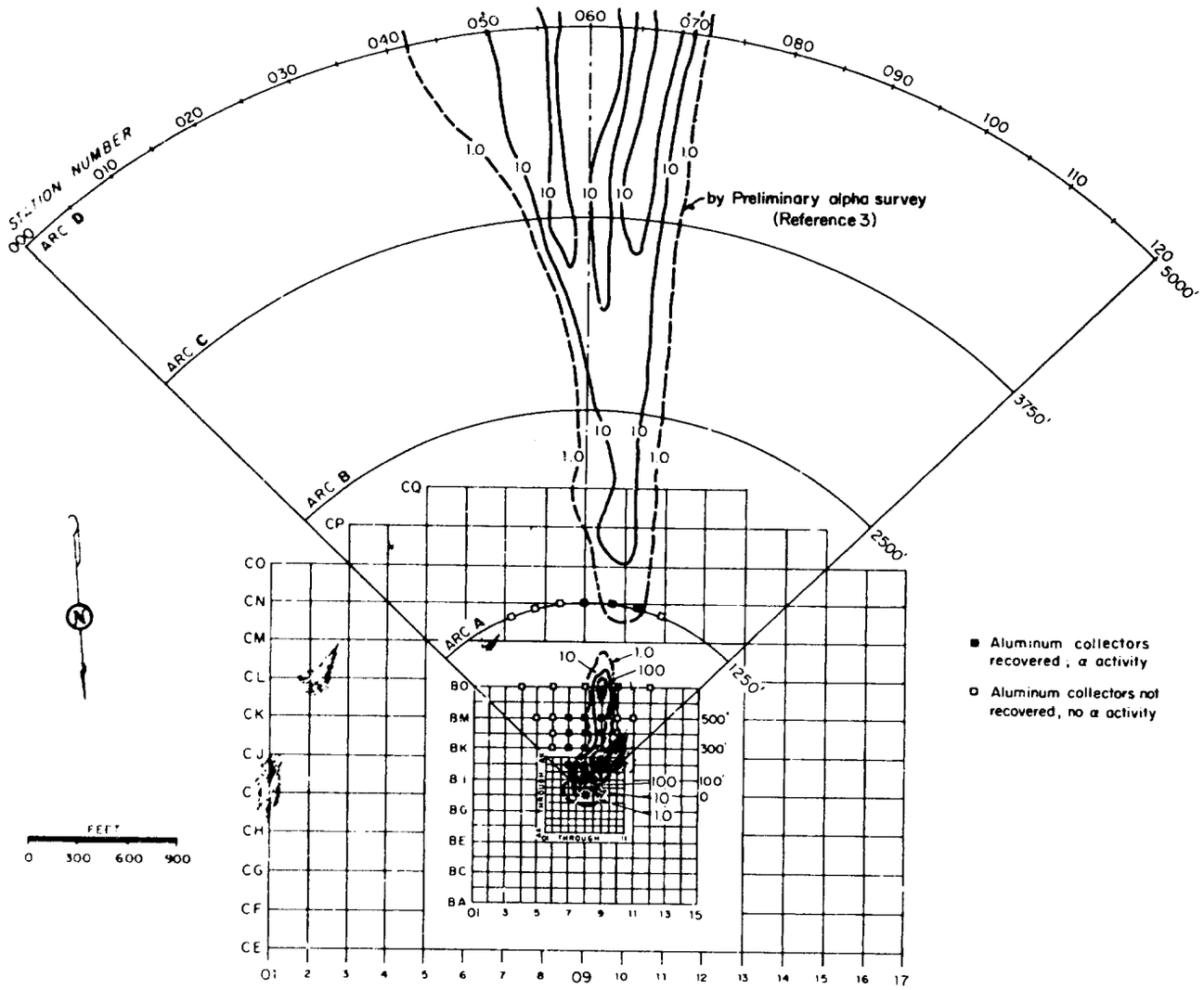


Figure 3.1(a) Location of aluminum collectors in downwind grid array, Double Tracks.

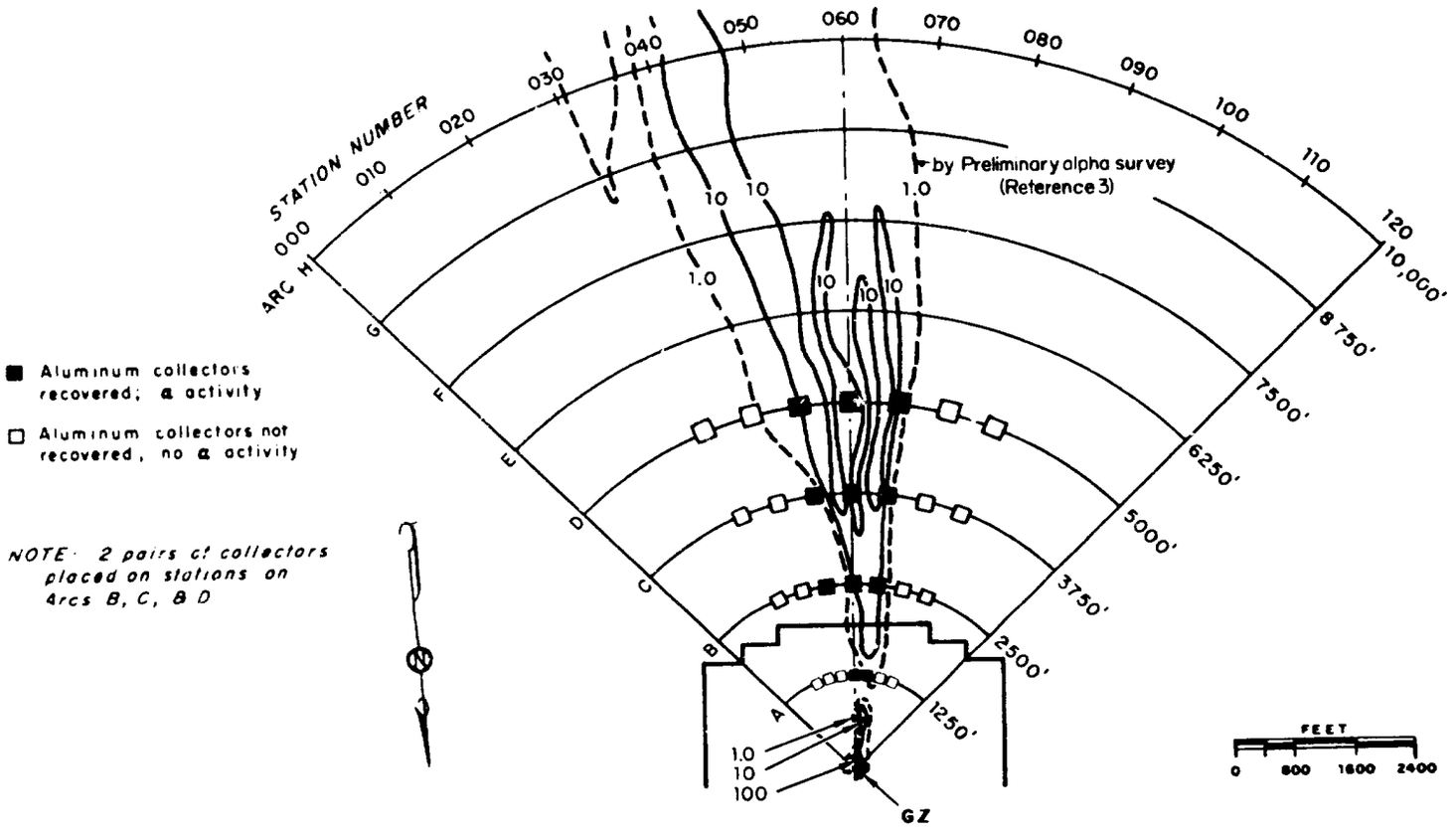


Figure 3.1(b) Location of aluminum collectors in downwind arc array, Double Tracks.

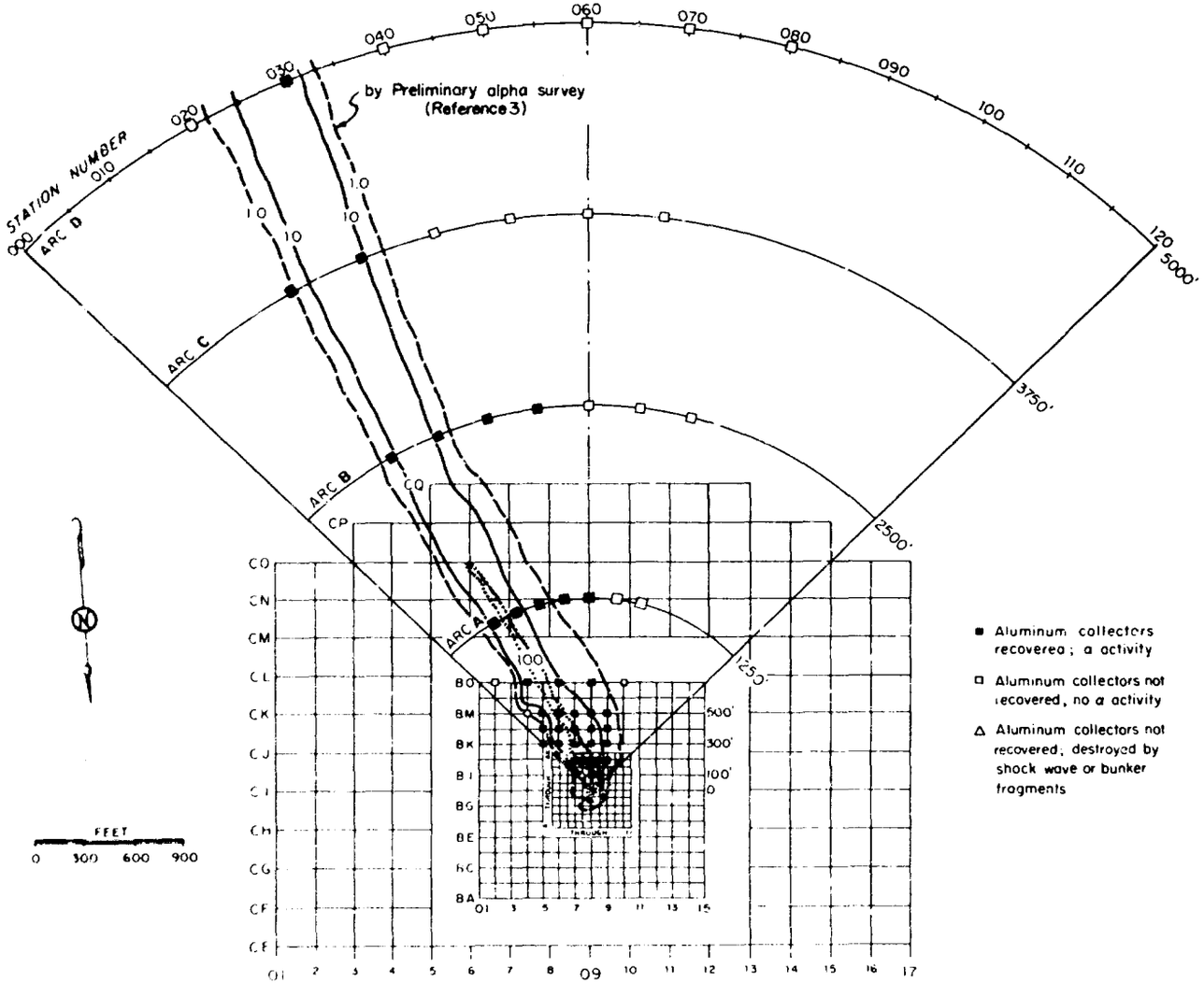


Figure 3.2(a) Location of aluminum collectors in downwind grid array, Clean Slate I.

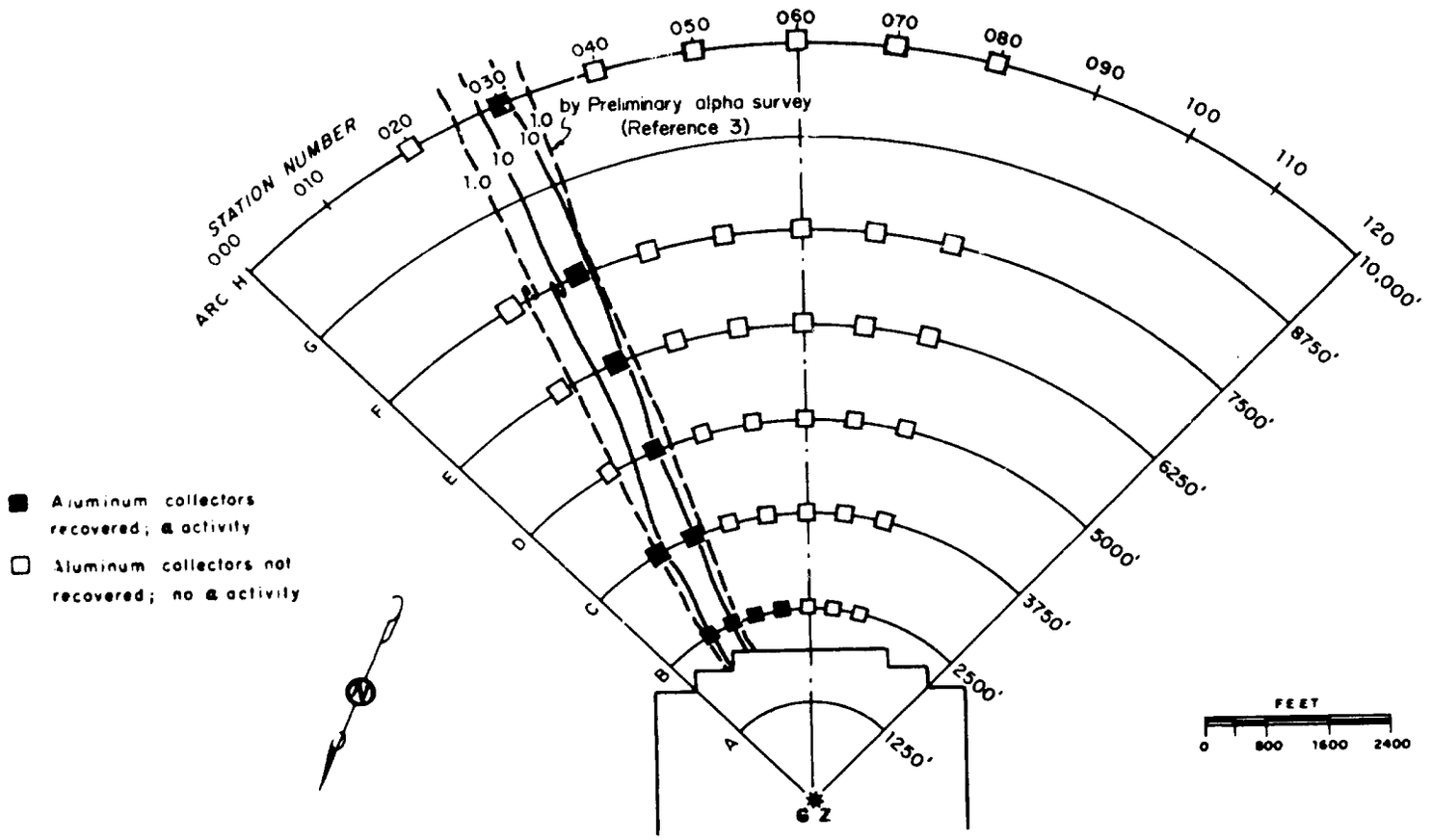


Figure 3.2(b) Location of aluminum collectors in downwind arc array, Clean Slate I.

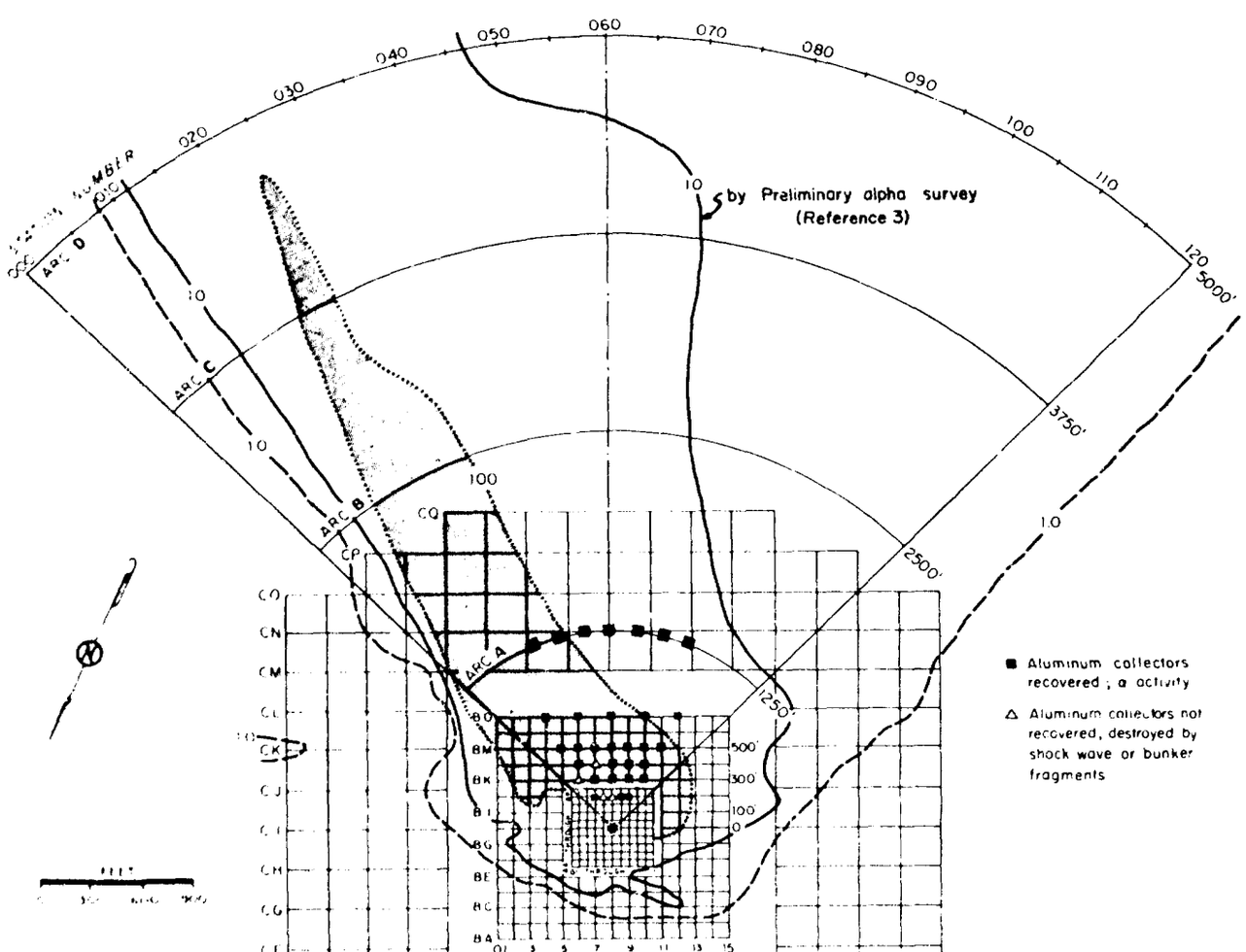


Figure 3.3(a) Location of aluminum collectors in downwind grid array, Clean Slate II.

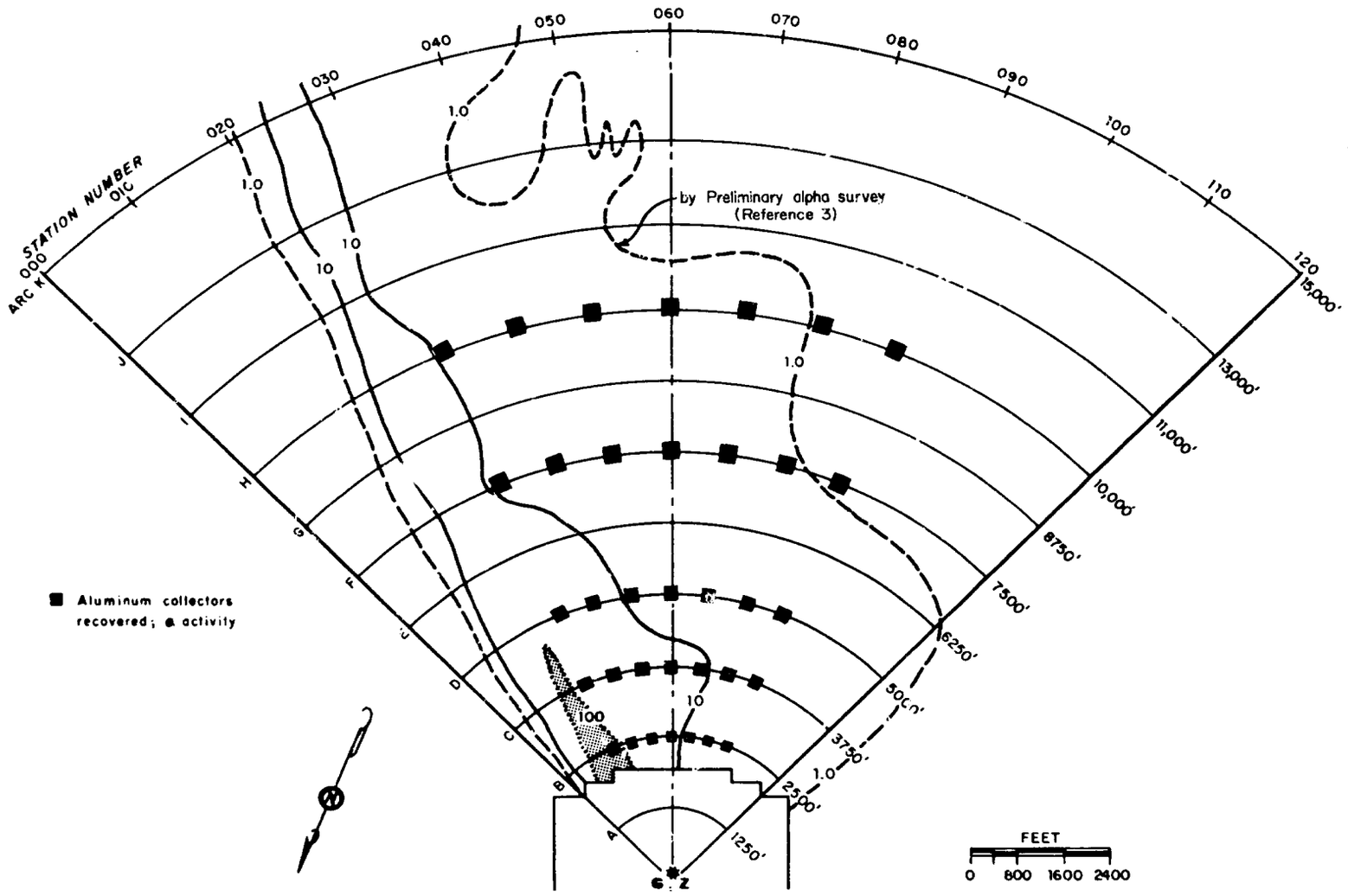
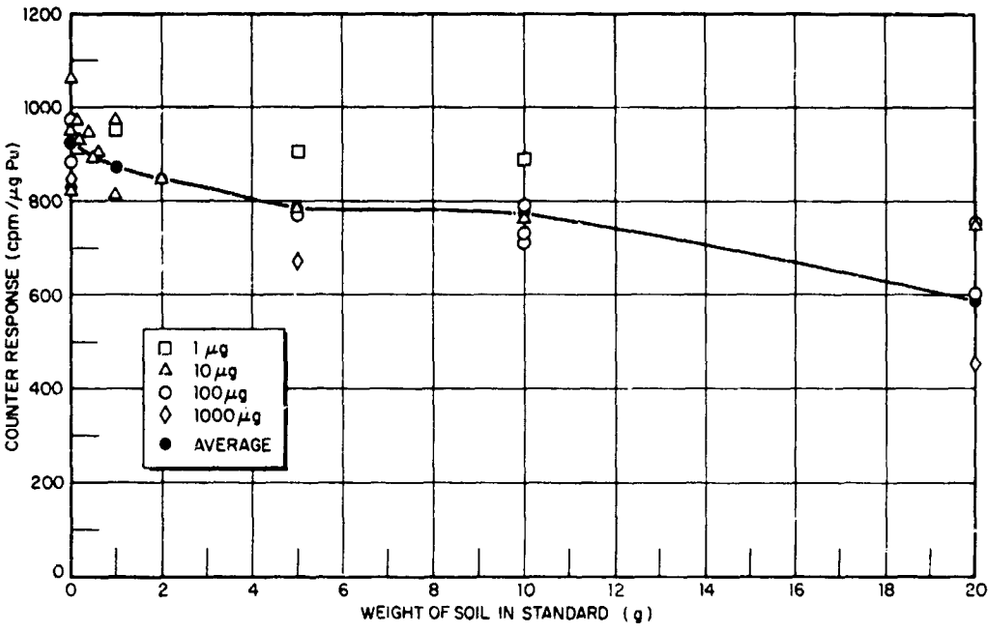


Figure 3.3(b) Location of aluminum collectors in downwind arc array, Clean Slate II.



Maximum weight of Roller Coaster samples or aliquots counted in well crystal was 10g.

Figure 3.4 Response of well-type crystal counter to Roller Coaster plutonium-soil standards at NRDL.

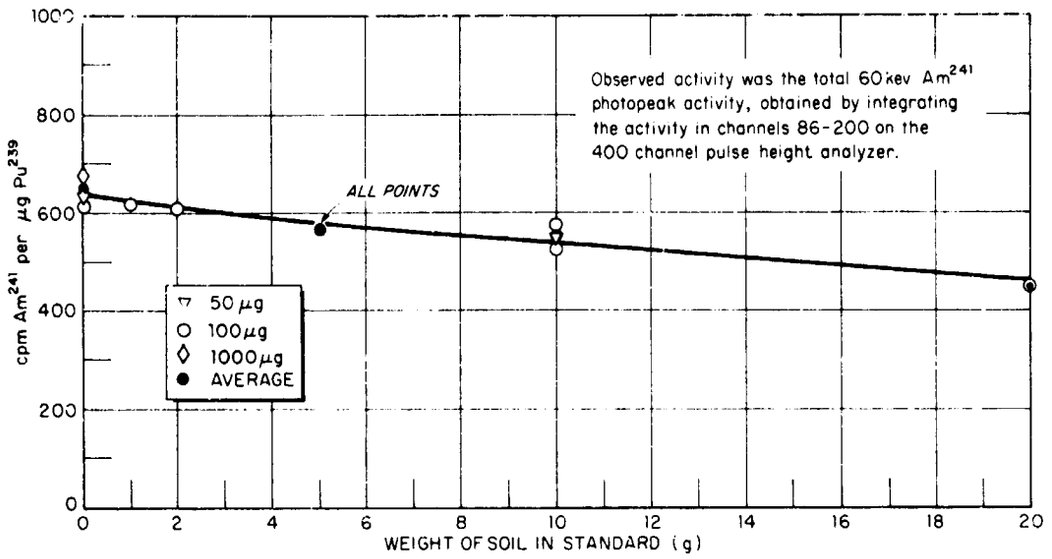


Figure 3.5 Plutonium content of Roller Coaster plutonium-soil standards as a function of observed activity and mass.

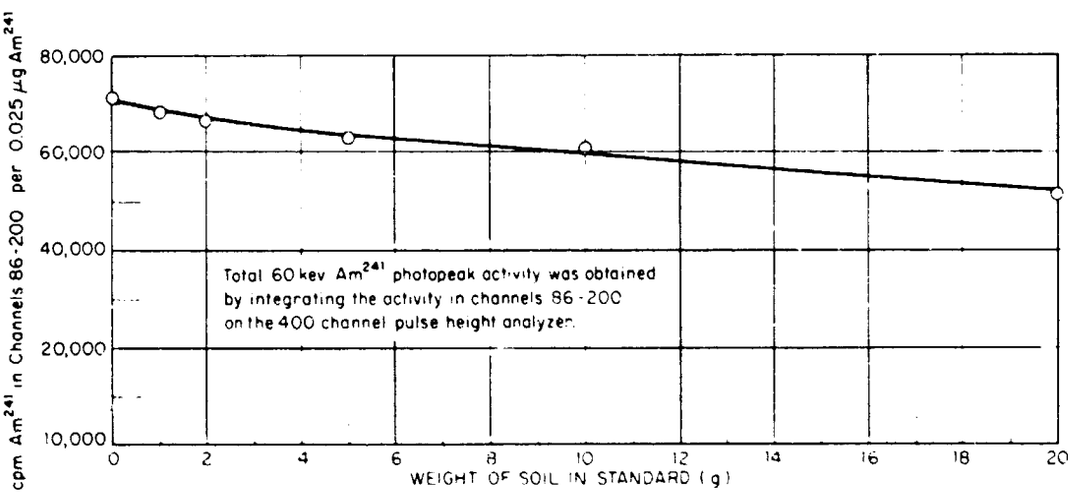


Figure 3.6 Observed activity of Am^{241} in Roller Coaster plutonium-soil standards as a function of sample mass.

CHAPTER 4

CONCLUSIONS AND RECOMMENDATIONS

The aims and objectives of the project have been fulfilled.

The aluminum fallout collectors (16 ft^2) provided plentiful amounts of easily recoverable fallout.

The three instrumental methods for determining plutonium in fallout samples, containing a large proportion of desert soil to plutonium, produced results that were comparabie to those obtained by radiochemical analyses. The three instrumental methods required no sample treatment, whereas the radiochemical method required tedious radiochemical separations and other procedures.

Counting the samples in a well-type NaI crystal was the easiest and least time-consuming, provided that the sample contained at least 0.5 μg of plutonium and also that reference standards of the source plutonium, or a standard of equivalent composition, were available.

Resolving the 60-kev Am^{241} gamma ray photopeak on a multichannel pulse-height analyzer was a similar method with similar sensitivity. It is more expensive and time-consuming, but it is not as sensitive to variations in sample size or to self-shielding or to absorption by the sample container. This method also requires a reference counting standard because of the constantly changing Am^{241}/Pu^{239} ratio.

Attempts to determine Pu^{239} by counting its easily absorbed and degraded 17-kev X-ray were not successful.

The neutron activation method is nearly as expensive and time-consuming as radiochemical analysis, but it does not destroy the physical integrity of the sample. It also allows U^{238} to be determined simultaneously with only a small additional effort. The lower limit of detection of the neutron activation method for

the samples analyzed on an as-is basis was 5×10^{-3} μg of Pu^{239} (compared to 5×10^{-7} μg for radiochemical methods). Unlike the gamma counting methods, this method was not affected by the time-variable Am^{241} content. The presence of U^{235}, however, could be a source of error, if its contribution to the gamma spectra of irradiated samples were not subtracted from the total observed.

The U^{238}/Pu^{239} ratio in unsieved samples was not only constant but was also close to the ratio of the weights of those isotopes in the device(s), indicating the absence of fractionation. This ratio, however, was not constant among the several particle-size fractions of the one DT sieved sample that was examined, indicating that fractionation of these two isotopes by particle size occurred.

The Am^{241}/Pu^{239} ratio was also constant, indicating that no fractionation of these two isotopes occurred. (Samples were analyzed over a period of time that was short enough to eliminate the effect of the increasing ratio with time.)

Mixing fallout with water and with an aqueous solution of Orvus and sodium hydroxide produced no dissolution of plutonium. Dilute hydrochloric acid dissolved 12 percent after 1 week of contact and 23 percent after 1 month of contact. About 6 percent of plutonium transferred to montmorillonite clay when an aqueous slurry of clay and fallout was mixed and allowed to stand. The amount transferred was the same whether the time of contact was 1 day, or 1 week, or 1 month. The partial solubility of plutonium in 0.1 N HCl may indicate the presence of some plutonium compound other insoluble PuO_2. No explanation is offered for the transfer of Pu from fallout particles to clay. It is significant, however, from the standpoint of decontaminating an area contaminated by the accidental explosion of a plutonium-containing device. A similar transfer of plutonium to concrete or soil could increase the effort necessary to decontaminate.

One to 27 percent of plutonium was present in the more dense material (> 4.30) reflecting the high density (11.2) of PuO_2. The high density material was black, very fine, and represented less than 5 percent of the sample weight. Thus, while as much as 27 percent of the plutonium oxide was free, or partially free, of soil, most fallout particles consisted of plutonium oxide particles attached to

larger particles of desert soil.

The distribution of mass and activity was the same, with sieves of 325 mesh (44 μ) and larger, whether determined by wet- or dry-sieving methods. Micromesh sieves were effectively used to extend particle-size data down to 10 μ from the usual 44-μ cutoff point.

The plutonium content of fallout on the aluminum collectors may be correlated with alpha survey data to help solve the problem of relating alpha survey meter readings to plutonium fallout levels.

Each of the three instrumental methods developed and used by Project 2.6a, as well as radiochemical methods, for determining the plutonium content of fallout samples has certain advantages and disadvantages. Selecting which to use requires that factors of speed, cost, availability of equipment, experience of personnel, and the required lower limit of detection be weighed and evaluated.

Almost no variation was observed in the activity of aliquots of samples, indicating that the plutonium was nearly uniformly distributed in the fallout.

APPENDIX A

GLOSSARY

AEA	United Kingdom Atomic Energy Authority
AEC	United States Atomic Energy Commission
cpm	counts per minute
CS I	Clean Slate 1 event
CS II	Clean Slate 2 event
DASA	Defense Atomic Support Agency
depletalloy	depleted uranium; uranium from which part of the U^{235} has been removed
DOD	Department of Defense
dpm	disintegrations per minute
DT	Double Tracks event
EIC	Eberline Instrument Company
EMI	Electronic Measurements, Inc.
FCWT	Field Command Weapons Effects and Tests Division
FP	fission product
GA	General Atomic Division of General Dynamics Corporation, La Jolla (San Diego), California
GZ	ground zero, location of detonation
HE	high explosive
H-NSC	Hazelton Nuclear Science Corporation, 4062 Fabian Way, Palo Alto, California
I I	Isotopes Incorporated, 123 Woodland Avenue, Westwood, New Jersey
LASL	Los Alamos Scientific Laboratory, Los Alamos, New Mexico
NRDL	U. S. Naval Radiological Defense Laboratory
NTSO	Nevada Test Site Organization

Orvus	industrial version of Tide, manufactured by Proctor and Gamble
RC	Operation Roller Coaster
RCP	reentry control point
REECO	Reynolds Electrical and Engineering Company
R-hour	time at which reentry and sample recovery commenced
T Lab	Tracerlab, 2030 Wright Avenue, Richmond 3, California
TMC	Technical Measurements Corporation
TTR	Tonopah Test Range

APPENDIX B

FOUR-PI IONIZATION CHAMBER RESPONSE TO A HYPOTHETICAL NEUTRON-IRRADIATED ROLLER COASTER FALLOUT SAMPLE

The original plan to determine the plutonium content of DT fallout samples was fairly simple. Samples of fallout, a sample of background soil, a sample of plutonium, and a mixture of background soil with plutonium were to be irradiated simultaneously in a reactor and then allowed to decay for at least 10 days. The 4π ion chamber response to the residual activity was to be a measure of the original plutonium, since nearly all such activity would come only from plutonium fission products. The lack of activity in the background soil sample would confirm this. The results of the calculations of the ion chamber response to the activity of irradiated fallout samples, shown in Figure B.1, bear out the validity of the planned procedure. This figure shows that almost all the ion chamber response after 10 days would be due to Pu^{239} fission products. The activity of the fission products from U^{235} in the device material is less than 1 percent of the activity of the Pu^{239} fission products. The planned procedure appeared to be a feasible method of determining plutonium in fallout samples known to contain plutonium and a known low ratio of uranium.

The calculations were based upon a sample containing 1,000 μg of Pu^{239} and 3.24 grams of Nevada desert soil. The plutonium value was derived from DASA, Air Force, and Navy documents in which 1,000 $\mu g/m^2$ is considered to be the lower limit of a hazardous deposit of plutonium. The weight of the soil was derived from an estimate of the amount of soil that would be lifted into the air by the detonation of HE in a device.

The chemical constitution of Nevada soil shown in Table B.1 was considered to be sufficiently representative of the Nevada desert soil to be used for preliminary activation calculations. There were to be no tracers added to the device

material[5]; if present, they might have contributed significantly to the activity of the irradiated sample.

The activity in the hypothetical neutron-irradiated DT fallout sample contributed by each isotope was calculated either from:

$$A = N\sigma\phi t \qquad \text{(B.1)}$$

or from:

$$A = N\sigma\phi(1-e^{-\lambda t}) \qquad \text{(B.2)}$$

Where: A = induced activity, disintegrations per second

N = number of atoms of susceptible isotope in sample

σ = cross section of susceptible isotope, 10^{-24} cm^2 (barns) per neutron

ϕ = neutron flux in reactor, neutrons per cm^2 per second

t = duration of irradiation, 600 seconds was used for all activation calculations

λ = decay constant of radioactive isotope produced by neutron irradiation, $seconds^{-1}$

Equation B.2 was used for calculating the induced activity of Al^{28} and Ca^{49} because their half-lives are short compared to the irradiation time; the activity of the other elements was calculated from Equation B.1. The assumed abundances of Pu^{239}, U^{235}, and U^{238} in the hypothetical DT fallout sample are shown in Table B.2.

To simplify the preliminary calculations, all neutron capture or fission was assumed to occur only at the end of the 600-second irradiation. In other words, it was assumed that no radioactive decay occurred during the irradiation period.

The 4π ionization chamber which was to be used is described in Reference 9. The response characteristics of most of the nuclides were taken from Reference 9. The response characteristics of Al^{28} and Ca^{49} were calculated from decay scheme information in Reference 10 by the method described in Reference 9. The responses for U^{239} and Np^{239} were calculated from decay scheme information in Reference 11.

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[5] Telephone conversation between Mr. D. Palmer, Assistant to the Scientific Director for Field Operations and the Project 2.6a Project Officer, 17 December 1962.

TABLE B.1 ELEMENTS OF INTEREST AND THEIR ABUNDANCE IN NEVADA DESERT SOIL

Element	Percent of Element in Nevada Soil (Reference 8)	Critical Isotope of Element	Percent of Critical Isotope in Naturally Occurring Element	Specific Weight of Critical Isotope in Nevada Soil (g of isotope/ g of soil)
Sodium	1.00	Na^{23}	100	1×10^{-2}
Manganese	0.06	Mn^{55}	100	6×10^{-4}
Aluminum	8.26	Al^{27}	100	8×10^{-2}
Silicon	26.37	Si^{30}	3.1	8×10^{-3}
Iron	0.84	Fe^{58}	0.03	2.8×10^{-5}
Potassium	2.44	K^{41}	6.9	1.7×10^{-3}
Calcium	7.69	Ca^{48}	0.2	1.4×10^{-4}

TABLE B.2 ABUNDANCE OF ISOTOPES OF HEAVY ELEMENTS IN A HYPOTHETICAL DOUBLE TRACKS FALLOUT SAMPLE

Isotope of Element	Percent of Element Associated With Hypothetical DT Fallout	Specific Weight of Isotope in Fallout (g of isotope/ g of fallout)
$Plutonium^{239}$	0.031	3×10^{-4}
$Uranium^{238}$	0.12	12×10^{-4}
$Uranium^{235}$	0.00036	3.6×10^{-6}

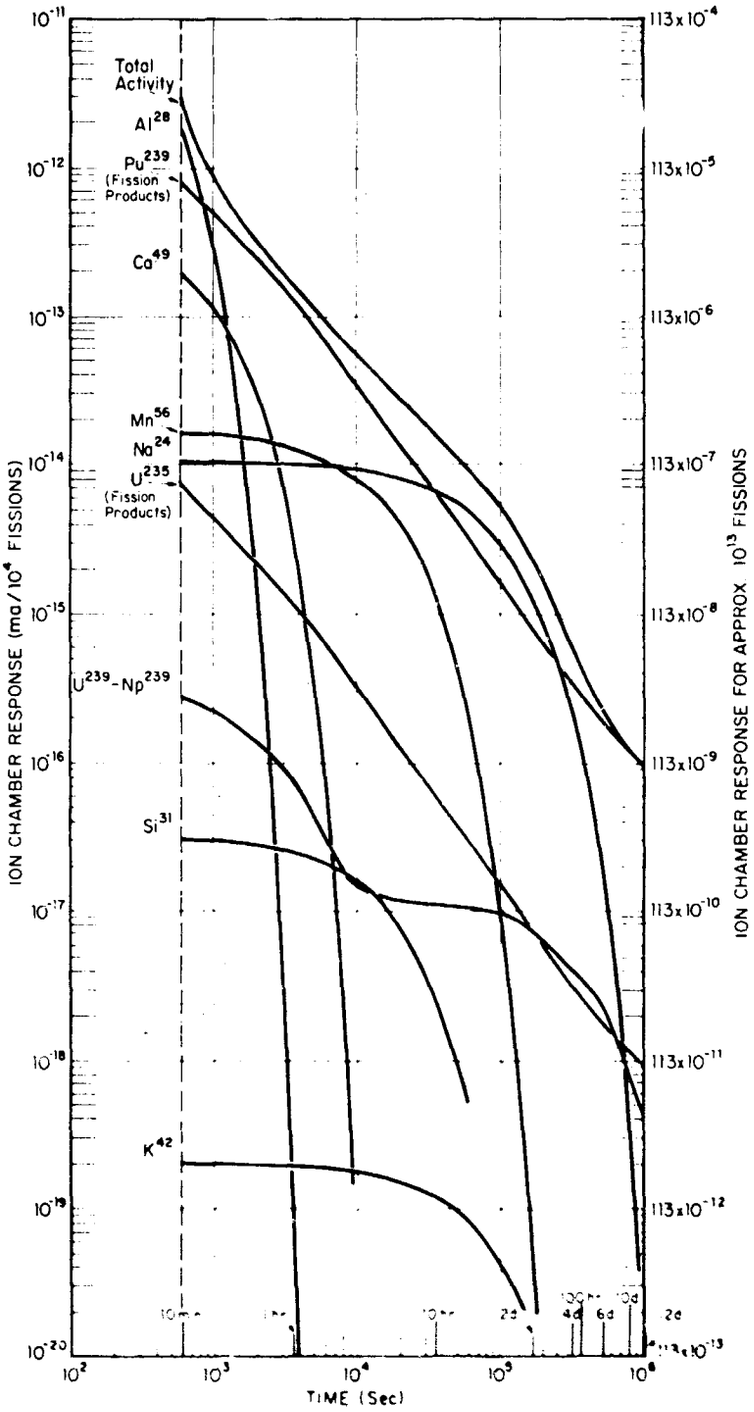


Figure B.1 Four-pi ionization chamber response to a hypothetical neutron-irradiated Double Tracks fallout sample.

APPENDIX C

ALPHA SURVEY DATA

All alpha survey (Tables C.1 through C.3) readings of the aluminum collectors were made with an EIC PAC 3G alpha survey instrument calibrated using a large-area, distributed plutonium source.

During recovery two readings were taken on each collector. One was taken about 1 foot from the left (east) side of the collector and the other about 1 foot from the right (west) side.

Nine readings were taken from symmetrically distributed points when the collector was on the teflon-covered wash rack before the fallout was washed off. These readings do not agree with those taken in the field. Nine more readings were taken in the same spots after the fallout had been removed with xylene.

TABLE C.1 DOUBLE TRACKS ALPHA SURVEY DATA [a]

Station Number	Collector Number	Alpha Readings During Recovery (PAC 3G cpm) Left	Alpha Readings During Recovery (PAC 3G cpm) Right	Alpha Readings Immediately [b] Prior to Removal of Fallout From Collector (PAC 3G cpm)		Alpha Readings Immediately [b] After Removal of Fallout From Collector (PAC 3G cpm)	
AH-05	1	20K	35K	6K	30K	100	300
"	2	15K	35K	20K	30K	100	300
AH-06	1	>100K	>100K	100K	800K	2K [c]	6K [c]
"	2	>100K	>100K	100K	600K	15K [c]	2.5K [c]
AH-07	1	>100K	>100K	20K	80K	2K [c]	6K [c]
"	2	>100K	>100K	50K	150K	300 [c]	2K [c]
AJ-04 [d]	1	Background	Background	50	350	0	50
"	2	7500	"	50	10K	0	50
AJ-05	1	570	400	200	600	50	150
"	2	170	200	150	750	50	200
AJ-06	1	40K	35K	15K	55K	200	350
"	2	40K	25K	25K	100K	200	350

(a) Only stations with detectable activity are listed.

(b) Of the nine counts taken on each collector only the maximum and minimum reading was recorded.

(c) The collector was rubbed with a Kimwipe moistened with xylene. Reduction in activity was barely detectable.

(d) Only reading came from a few black spheres reading 10K to 20K.

TABLE C.1 CONTINUED [a]

Station Number	Collector Number	Alpha Readings During Recovery (PAC 3G cpm) Left	Right	Alpha Readings Immediately [b] Prior to Removal of Fallout From Collector (PAC 3G cpm) Minimum	Maximum	Alpha Readings Immediately [b] After Removal of Fallout From Collector (PAC 3G cpm) Maximum	Minimum
AJ-07*	1	➤100K	➤100K	40K	120K	250	2K
"	2	➤100K	➤100K	30K	100K	1K	7.5K
AJ-08	1	3500	300	1.5K	10K	100	250
"	2	250	250	2K	6K	50	300
BK-06	1	-0-	-0-				
"	2	-0-	-0-				
BK-07	1	500	100	100	1K	100	500
"	2	400	-0-	-0- +0-	100	100	500
BK-08	1	1000	1500	2K	6K	0	100
"	2	1000	5000	250	2K	50	300
BK-09	1	100K	10K	2K	25K	0	50
"	2	100K	10K	1K	25K	0	50
BK-10	1	50	100				
"	2	100	50				

(a) Only stations with detectable activity are listed.
(b) Of the nine counts taken on each collector, only the maximum and minimum reading was recorded.
* Peppered with black spheres.

TABLE C.1 CONTINUED [a]

Station Number	Collector Number	Alpha Readings During Recovery (PAC 3G cpm) Left	Right	Alpha Readings Immediately [b] Prior to Removal of Fallout From Collector (PAC 3G cpm) Minimum	Maximum	Alpha Readings Immediately [b] After Removal of Fallout From Collector (PAC 3G cpm)	
BL-08*	1	50	700	5K	50K		
"	2	70	500	3.5K	60K		
BL-09	1	➢100K	➢100K	5K	50K	50	1.5K
"	2	➢100K	➢100K	3 5K	60K	50	1K
BM-07	1	350	6000				
"	2	-0-	250				
BM-08	1	500	100				
"	2	100	500				
BM-09	1	35K	80K				
"	2	80K	50K				
BO-12**	1	-0-	-0-				
"	2	2500	-0-				

(a) Only stations with detectable activity are listed.
(b) Of the nine counts taken on each collector, only the maximum and minimum reading was recorded.
* 1 Black Sphere read 50K.
** One hot spot read ➢100K but nothing visible.

TABLE C.1 CONTINUED [a]

Station Number	Collector Number	Alpha Readings During Recovery (PAC 3G cpm) Left	Right	Station Number	Collector Number	Alpha Readings During Recovery (PAC 3G cpm) Left	Right
A-050	1	20	20	B-060	1	250	2.5K
"	2	20	20	"	2	4K	2.1K
A-060	1	50	40	"	3	900	150
"	2	30	2000		4	3.4K	1.1K
A-070	1	70K	75K	B-070	1	13K	12K
"	2	60K	65K	"	2	10K	10K
A-080	1	250	50	"	3	17K	11K
"	2	50	20	"	4	12K	15K
B-050	1	800	750	C-050	1	1K	1K
"	2	450	300	"	2	2K	4K
"	3	600	320	"	3	1K	2.5K
"	4	500	500	"	4	2K	3.5K

(a) Only stations with detectable activity are listed.

TABLE C.1 CONTINUED [a]

Station Number	Collector Number	Alpha Readings During Recovery (PAC 3G cpm) Left	Right	Alpha Readings Immediately [b] Prior to Removal of Fallout From Collector (PAC 3G cpm)		Alpha Readings Immediately [b] After Removal of Fallout From Collector (PAC 3G cpm)	
C-060	1	2.5K	5K				
"	2	10K	1K				
"	3	2.5K	3K				
"	4	6K	5K				
C-070	1	3K	3K				
"	2	2.5K	4K				
"	3	2.5K	1.5K				
"	4	3.5K	3.5K				
D-050	1	7K	6.5K				
"	2	8.5K	7.5K	9K	140K	1.5K	2K
"	3	7K	600				
"	4	7.5K	5.5K				

(a) Only stations with detectable activity are listed.
(b) Of the nine counts taken on each collector, only the maximum and minimum reading was recorded.

TABLE C.1 CONTINUED [a]

Station Number	Collector Number	Alpha Readings During Recovery (PAC 3G cpm) Left	Right	Alpha Readings Immediately [b] Prior to Removal of Fallout From Collector (PAC 3G cpm)	Alpha Readings Immediately [b] After Removal of Fallout From Collector (PAC 3G cpm)
D-060	1	2K	3K		
"	2	2K	3K		
"	3	4K	3.5K		
"	4	4.5K	3K		
D-070	1	2K	3K		
"	2	1.5K	3K		
"	3	1.5K	3.5K		
"	4	2.5K	3.0K		

(a) Only stations with detectable activity are listed.

TABLE C.2 CLEAN SLATE I ALPHA SURVEY DATA [a]

Sample Number	Collector Number	Alpha Readings During Recovery (PAC 3G cpm) Left	Right	Alpha Readings Immediately Prior to Removal of Fallout From Collector (PAC 3G cpm)			Alpha Readings Immediately After Removal of Fallout From Collector (PAC 3G cpm)		
AH-05	Destroyed by Blast								
AH-06	1	60K	120K	50K	30K	25K	100	150	25
				20K	30K	15K	350	50	100
				10K	15K	20K	100	125	50
"	2	120K	160K	12.5K	12.5K	10K	100	50	50
		20% of #2 Collector		10K	12.5K	15K	25	100	100
		was covered by #1		12.5K	10K	15K	100	50	50
AH-07	1	50K	60K	40K	30K	35K	50	150	200
				35K	20K	22.5K	150	150	250
				25K	15K	15K	300	200	250
"	2	50K	80K	7K	4.5K	5.5K	75	100	50
				3.5K	5K	6.5K	150	200	100
				5K	5.5K	7.5K	100	200	150
AJ-04	1	25K	30K	8.5K	9.5K	1.5K	100	50	50
				6K	10K	25K	50	75	50
				6K	10K	5.5K	150	200	150
"	2	50K	35K	2.5K	2.5K	2K	50	75	150
				2K	2.5K	2K	175	50	50
				3.5K	2K	2.5K	50	100	150

(a) Only stations with detectable activity are listed.

TABLE C.2 CONTINUED [a]

Sample Number	Collector Number	Alpha Readings During Recovery (PAC 3G cpm) Left	Right	Alpha Readings Immediately Prior to Removal of Fallout From Collector (PAC 3G cpm)			Alpha Readings Immediately After Removal of Fallout From Collector (PAC 3G cpm)		
AJ-05	1	70K	60K	15K	15K	40K	75	50	100
				35K	20K	35K	200	250	300
				25K	25K	30K	175	100	250
"	2	80K	110K	6.5K	7.5K	20K	75	150	250
				6K	10K	15K	200	300	350
				9K	12.5K	20K	250	300	300
AJ-06	1	130K	80K	8.5K	9K	9.5K	150	200	250
				10K	30K	22.5K	150	200	200
				12.5K	15K	12.5K	200	250	800
"	2	100K	100K	6K	5.5K	6K	200	150	200
				5.5K	5K	5.5K	50	150	175
				4.5K	4.5K	7K	150	150	200
AJ-07	1	60K	25K	15K	6.5K	9.5K	200	150	200
				25K	45K	40K	150	150	150
				25K	15K	12.5K	100	150	50
"	2	75K	90K	9.5K	8.5K	7K	50	100	125
				12K	15K	15K	150	75	200
				9.5K	10K	5K	250	175	200

[a] Only stations with detectable activity are listed.

TABLE C.2 CONTINUED [a]

Sample Number	Collector Number	Alpha Readings During Recovery (PAC 3G cpm) Left	Right	Alpha Readings Immediately Prior to Removal of Fallout From Collector (PAC 3G cpm)			Alpha Readings Immediately After Removal of Fallout From Collector (PAC 3G cpm)		
AJ-08	1	1.5K	1.5K	400	950	1K	150	50	50
				250	600	600	50	50	50
				350	600	700	50	50	50
"	2	2K	2K	1K	650	600	50	75	50
				800	500	600	150	100	75
				900	700	400	50	75	100
BK-05	1	250	150	50		750			
"	2	250	500						
BK-06	1	25K	10K	6K	7.5K	7K	100	75	125
				10K	5K	3.5K	100	75	150
				12.5K	5K	4K	100	25	25
"	2	4.5K	8K	2K	8K	4K	50	225	225
				1.5K	4K	7K	100	25	250
				7K	1.5K	4K	175	100	200
BK-07	1	100K	60K	45K	27.5K	60K	150	150	200
				27.5K	37.5K	45K	125	50	100
				40K	40K	32.5K	100	150	200
"	2	60K	70K	20K	10.5K	20K	150	150	100
				10K	10K	20K	150	200	50
				20K	10K	10.5K	75	150	150

(a) Only stations with detectable activity are listed.

TABLE C.2 CONTINUED [a]

Sample Number	Collector Number	Alpha Readings During Recovery (PAC 3G cpm) Left	Right	Alpha Readings Immediately Prior to Removal of Fallout From Collector (PAC 3G cpm)			Alpha Readings Immediately After Removal of Fallout From Collector (PAC 3G cpm)		
BK-08	1	120K	100K	140K	80K	80K	1K	150	350
				60K	100K	100K	450	300	625
				110K	110K	100K	800	1K	2K
"	2	40K	40K	60K	50K	75K	1K	150	150
				40K	55K	85K	150	100	200
				40K	50K	65K	115	300	200
BK-09	1	5K	8.5K	5.5K	6.5K	5K	100	75	75
				5.5K	8K	8.5K	125	100	100
				9K	8K	8.5K	150	50	100
"	2	20K	5K	2.5K	3K	2.5K	75	125	75
				2.5K	2.5K	5.5K	50	100	50
				4K	3K	4K	75	75	50
BL-05	1	200	100	0	200	50	0	0	0
				0	0	0	0	25	0
				0	500	0	0	50	0
"	2	3K	7K	0	0	75	25	50	0
				0	50	50	0	25	25
				0	0	0	50	50	50

(a) Only stations with detectable activity are listed.

TABLE C.2 CONTINUED [a]

Sample Number	Collector Number	Alpha Readings During Recovery (PAC 3G cpm) Left	Right	Alpha Readings Immediately Prior to Removal of Fallout From Collector (PAC 3G cpm)			Alpha Readings Immediately After Removal of Fallout From Collector (PAC 3G cpm)		
BL-06	1	65K	35K	30K	15K	50K	50	50	50
				10K	20K	25K	350	50	1K
				10K	20K	15K	250	200	400
"	2	30K	50K	7K	3K	6K	50	100	100
				5K	6K	5K	100	0	50
				4K	4.5K	9K	175	175	200
BL-07	1	70K	65K	77.5K	87.5K	80K	250	200	175
				90K	65K	95K	100	200	250
				95K	75K	70K	225	175	150
"	2	70K	75K	45K	50K	55K	200	150	125
				50K	45K	60K	200	100	100
				50K	60K	40K	200	200	175
BL-08	1	40K	40K	15K	12.5K	20K	150	250	950
				17.5K	15K	125K	1.5K	100	1K
				15K	17.5K	17.5K	100	50	500
"	2	30K	35K	20K	17.5K	17.5K	400	250	450
				20K	25K	27.5K	1K	50	1K
				20K	15K	20K	50	50	150

(a) Only stations with detectable activity are listed.

TABLE C.2 CONTINUED [a]

Sample Number	Collector Number	Alpha Readings During Recovery (PAC 3G cpm) Left	Right	Alpha Readings Immediately Prior to Removal of Fallout From Collector (PAC 3G cpm)			Alpha Readings Immediately After Removal of Fallout From Collector (PAC 3G cpm)		
BL-09	1	25K	2K	2K	3K	2.5K	0	0	0
				2.5K	3K	2K	0	0	0
				2K	2.5K	1.5K	0	50	0
"	2	2K	2K	1.5K	1.5K	2K	0	0	25
				2K	2K	1.5K	0	50	25
				2K	2K	2K	25	25	50
BM-05	1	4.5K	5K	15K	15K	12.5K	0	75	50
				10K	12.5K	20K	100	100	50
				2.5K	9K	8.5K	50	150	100
"	2	3K	7K	3K	8.5K	2K	25	50	0
				12.5K	15K	10K	0	25	25
				7.5K	12.5K	9.5K	50	50	50
BM-06	1	45K	75K	50K	40K	30K	150	300	100
				50K	40K	90K	200	100	100
				30K	30K	20K	300	200	50
"	2	50K	100K	50K	18K	20K	100	125	75
				40K	30K	35K	150	125	50
				30K	40K	55K	100	75	0

(a) Only stations with detectable activity are listed.

TABLE C.2 CONTINUED [a]

Sample Number	Collector Number	Alpha Readings During Recovery (PAC 3G cpm) Left	Right	Alpha Readings Immediately Prior to Removal of Fallout From Collector (PAC 3G cpm)			Alpha Readings Immediately After Removal of Fallout From Collector (PAC 3G cpm)		
BM-07	1	9.5K	15K	30K	27.5K	37.5K	75	100	100
				32.5K	25K	25K	150	100	150
				32.5K	25K	25K	200	250	250
"	2	9.5K	10K	27.5K	30K	25K	15	50	100
				22.5K	25K	20K	50	100	150
				20K	25K	30K	75	75	25
BM-08	1	7K	6K	7K	8.5K	7K	50	100	50
				7K	8K	7.5K	100	200	100
				6K	9.5K	10K	100	200	250
"	2	10K	6.5K	7.5K	9K	7K	50	50	50
				8.5K	6K	10K	150	250	100
				8K	10K	12.5K	150	500	150
BM-09	1	900	850	200	900	950	25	0	0
				800	200	750	25	25	0
				600	600	200	0	25	25
"	2	4K	700	400	450	425	75	50	0
				150	300	200	0	0	0
				300	75	400	50	50	0

(a) Only stations with detectable activity are listed.

TABLE C.2 CONTINUED [a]

Sample Number	Collector Number	Alpha Readings During Recovery (PAC 3G cpm) Left	Right	Alpha Readings Immediately Prior to Removal of Fallout From Collector (PAC 3G cpm)			Alpha Readings Immediately After Removal of Fallout From Collector (PAC 3G cpm)		
BO-04	1	3.5K	3.5K	7K	9.5K	7K	0	25	75
				8K	9.5K	5.5K	75	50	125
				5K	6.5K	4.5K	100	100	50
"	2	3.5K	4.5K	8.5K	10K	15K	150	50	50
				15K	15K	12.5K	50	100	75
				10K	12.5K	12.5K	50	50	75
BO-6	1	7K	6K	No data before washing.			25	75	125
							125	100	100
							25	50	125
"	2	6.5K	8K	30K	30K	25K	150	75	100
				27.5K	40K	35K	125	50	200
				22.5K	20K	20K	50	75	25
BO-08	1	450	-	950	850	1.5K	0	0	0
				750	1K	1K	50	50	50
				1K	1K	950	50	100	100
"	2	-	-	550	900	650	50	25	0
				500	900	500	0	0	0
				900	2K	1.5K	0	50	25

(a) Only stations with detectable activity are listed.

TABLE C.2 CONTINUED [a]

Sample Number	Collector Number	Alpha Readings During Recovery (PAC 3G cpm) Left	Right	Alpha Readings Immediately Prior to Removal of Fallout From Collector (PAC 3G cpm)			Alpha Readings Immediately After Removal of Fallout From Collector (PAC 3G cpm)		
A-020	1	10K	15K*	7.5K	10K	10K	0	0	0
				10K	10K	15K	250	100	0
				10K	10K	12K	0	50	0
"	2	15K*	20K	5K	10K	15K	0	25	50
				12K	10K	10K	100	100	300
				12K	10K	15K	0	50	0
A-030	1	35K*	25K	17.5K	20K	15K	0	0	100
				15K	15K	20K	50	1K	450
				17.5K	15K	20K	0	0	0
"	2	25K*	25K	15K	15K	15K	250	100	200
				17.5K	15K	20K	1K	50	200
				15K	15K	15K	0	0	150
A-040	1	550	450	650	300	450	0	0	0
				450	300	300	0	0	0
				300	300	400	25	25	0
"	2	600	750	400	250	200	0	0	0
				350	200	475	0	50	0
				125	300	250	0	50	50

*Black metallic spherical particle burned through 0.003-inch aluminum foil.

(a) Only stations with detectable activity are listed.

TABLE C.2 CONTINUED [a]

Sample Number	Collector Number	Alpha Readings During Recovery (PAC 3G cpm) Left	Right	Alpha Readings Immediately Prior to Removal of Fallout From Collector (PAC 3G cpm)			Alpha Readings Immediately After Removal of Fallout From Collector (PAC 3G cpm)		
A-050	1	750	350	250	150	175	0	0	0
				200	175	125	0	0	0
				100	500	225	0	0	0
"	2	500	500	225	150	200	0	0	0
				325	200	100	0	0	0
				225	525	250	0	0	0
A-060	1	300	200	75	200	100	0	0	0
				100	100	125	0	0	0
				100	100	200	0	0	0
"	2	200	400	125	200	75	0	0	0
				150	75	100	0	0	0
				150	150	150	0	0	0
B-020	1	5K	5.5K	5K	5.5K	3.5K	200	250	150
				5K	5K	4.5K	250	200	150
				5K	4.5K	5K	100	100	100
"	2	5K	6.5K	3.5K	4K	5.5K	0	0	0
				5.5K	5.5K	5K	200	200	600
				4K	4.5K	5K	0	50	0

(a) Only stations with detectable activity are listed.

TABLE C.2 CONTINUED [a]

Sample Number	Collector Number	Alpha Readings During Recovery (PAC 3G cpm) Left	Right	Alpha Readings Immediately Prior to Removal of Fallout From Collector (PAC 3G cpm)			Alpha Readings Immediately After Removal of Fallout From Collector (PAC 3G cpm)		
B-030	1	7.5K	8.5K	10K	13K	10K	0	0	0
				10K	10K	5K	50	250	100
				5K	7K	9K	0	250	100
"	2	6K	6K	3.5K	4K	7K	250	400	100
				5.5K	9K	5.5K	450	350	200
				3.5K	5K	4.5K	100	350	350
B-040	1	150	250	250	200	200	0	0	0
				200	150	200	0	0	0
				200	200	200	0	0	0
"	2	150	200	150	150	100	75	0	0
				100	150	200	0	0	0
				50	100	125	0	0	0
B-050	1	100	200	100	75	100	0	0	0
				50	100	100	0	0	0
				50	50	50	0	0	0
"	2	200	200	50	50	75	0	0	0
				25	50	175	0	0	0
				75	150	100	0	0	0

(a) Only stations with detectable activity are listed.

TABLE C.2 CONTINUED [a]

Sample Number	Collector Number	Alpha Readings During Recovery (PAC 3G cpm) Left	Right	Alpha Readings Immediately Prior to Removal of Fallout From Collector (PAC 3G cpm)			Alpha Readings Immediately After Removal of Fallout From Collector (PAC 3G cpm)		
C-020	1	3K	3K	150	350	400	0	25	0
				200	300	400	0	0	0
				300	400	400	50	50	0
"	2	2K	2K	100	350	150	25	25	0
				100	200	150	0	0	0
				0	100	150	0	0	0
C-030	1	8K	9.5K	8K	7K	7K	25	50	75
				9.5K	7.5K	9.5K	50	75	0
				10K	7K	8.5K	0	25	25
"	2	10K	9K	6K	7.5K	4K	25	25	0
				6.5K	9K	8K	50	25	50
				8.5K	9.5K	5K	50	25	25
D-030	1	8.5K	8.5K	750	950	950	50	100	100
				1K	800	700	50	75	50
				1K	700	1K	100	75	100
"	2	20K	10K	7.5K	8K	9K	50	100	150
				8K	8K	10K	150	200	200
				15K	8K	8.5K	250	100	50

(a) Only stations with detectable activity are listed.

TABLE C.2 CONTINUED [a]

Sample Number	Collector Number	Alpha Readings During Recovery (PAC 3G cpm) Left	Righe	Alpha Readings Immediately Prior to Removal of Fallout From Collector (PAC 3G cpm)			Alpha Readings Immediately After Removal of Fallout From Collector (PAC 3G cpm)		
F-030	1	20K	15K	9.5K	7.5K	8K	50	25	150
				7K	8K	8K	50	75	75
				10K	10K	9.5K	150	200	100
"	2	10K	15K	10K	12.5K	9.5K	275	300	50
				15K	12.5K	20K	50	200	150
				15K	12.5K	17K	100	150	50
H-030	1	8.5K	8K	8.5K	8.5K	8K	200	350	250
				9.5K	9K	8.5K	300	1.5K	550
				9K	9K	10K	250	200	300
"	2	8K	8.5K	8.5K	9K	7.5K	50	450	200
				7.5K	8K	7K	350	2K	550
				10K	12.5K	9K	250	550	200

(a) Only stations with detectable activity are listed.

TABLE C.3 CLEAN SLATE II ALPHA SURVEY DATA [a]

Sample Number	Collector Number	Alpha Readings During Recovery (PAC 3G cpm) Left	Right	Alpha Readings Immediately Prior to Removal of Fallout From Collector (PAC 3G cpm)			Alpha Readings Immediately After Removal of Fallout From Collector (PAC 3G cpm)		
AJ-04	1	45K	55K	50K	60K	50K	100	100	50
				10K	50K	30K	50	25	100
				20K	20K	30K	50	75	100
"	2	47.5K	42.5K	30K	30.6K	30K	100	50	100
				40K	40K	40.5K	100	150	100
				50K	40.5K	40K	150	150	100
AJ-07	1	67.5	70K	65K	65K	60.5K	100	150	100
				55.5K	40K	55K	200	150	200
				25K	20.5K	15K	200	200	200
"	2	75K	65K	45K	40.5K	40.5K	100	0	50
				30K	35K	65K	100	100	100
				30K	35.5K	35.5K	100	50	150
AJ-08	1	72.5K	72.5K	55.5K	75K	55K	200	150	150
				70.5K	80K	75K	200	200	200
				60.5K	70K	70.5K	200	200	200
"	2	72.5K	72.5K	35.5K	75K	85.5K	150	50	100
				50.5K	75.5K	70K	200	200	200
				50.5K	55K	60.5K	200	200	150

(a) Only stations with detectable activity are listed.

TABLE C.3 CONTINUED [a]

Sample Number	Collector Number	Alpha Readings During Recovery (PAC 3G cpm) Left	Right	Alpha Readings Immediately Prior to Removal of Fallout From Collector (PAC 3G cpm)			Alpha Readings Immediately After Removal of Fallout From Collector (PAC 3G cpm)		
BK-07	1	67.5K	65K	50.5K	30.5K	20K	100	150	100
				60K	30K	10K	50	150	100
				50K	30K	40.5K	100	100	100
"	2	57.5K	60K	40.5K	50K	50.5K	50	50	100
				60K	30K	60K	100	150	50
				10.5K	25K	50K	100	150	150
BK-08	1	55K	57.5K	No other reading was taken.					
	2	62.5K	52.5K						
BK-09	1	72.5K	75K	50K	70K	55.5K	50	150	150
				50K	55.5K	30K	100	150	150
				45.5K	60K	50.5K	50	100	150
	2	72.5K	75K	40.5K	45.5K	50K	100	100	150
				30K	60.5K	60K	100	50	150
				45K	55K	30K	150	150	20
BK-10	1	100K	97.5K	70.5K	80K	40.5K	0	50	50
				70.5K	75K	50.5K	100	100	150
				75.5K	70K	75K	200	200	200
"	2	97.5K	97.5K	65K	85K	70.5K	350	450	450
				85K	70K	80.5K	500	500	550
				80K	85.5K	85.5K	350	400	400

(a) Only stations with detectable activity are listed.

TABLE C.3 CONTINUED [a]

Sample Number	Collector Number	Alpha Readings During Recovery (PAC 3G cpm) Left	Right	Alpha Readings Immediately Prior to Removal of Fallout From Collector (PAC 3G cpm)			Alpha Readings Immediately After Removal of Fallout From Collector (PAC 3G cpm)		
BL-06	1	72.5K	90K	70.5K	60K	60K	500	400	300
				60K	40K	30K	500	300	500
				60.5K	25K	30K	500	500	500
"	2	60K	90K	50K	60K	60K	400	600	650
				50K	40.5K	50.5K	500	500	500
				50K	30K	50K	400	500	500
BL-07	Not Recovered.	80K	80K						
BL-08	1	60K	65K	15K	5.5K	30.5K	100	50	100
				15.5K	5.5K	25K	100	100	50
				5.5K	5.5K	30.5K	50	150	100
"	2	65K	60K	40K	35K	30.5K	150	100	100
				20K	20K	15.5K	50	150	100
				40K	20K	15.5K	50	100	100
BL-09	1	67.5K	67.5K	35.5K	50K	55.5K	100	250	300
				30.5K	45.5K	65K	450	550	600
				40.5K	35.5K	65K	400	500	450
"	2	65K	67.5K	35K	35.5K	55K	200	250	150
				35.5K	35.5K	40.5K	100	300	250
				35K	30K	30.5K	200	250	150

(a) Only stations with detectable activity are listed.

TABLE C.3 CONTINUED [a]

Sample Number	Collector Number	Alpha Readings During Recovery (PAC 3G cpm) Left	Right	Alpha Readings Immediately Prior to Removal of Fallout From Collector (PAC 3G cpm)			Alpha Readings Immediately After Removal of Fallout From Collector (PAC 3G cpm)		
BL-10	1	95K	90K	60K	65K	70K	300	350	200
				55.5K	70.5K	55.5K	200	200	200
				40K	75K	50.5K	300	300	250
"	2	95K	95K	75K	60.5K	30.5K	300	50	100
				50.5K	30K	30K	0	150	100
				30.5K	40K	25K	200	150	100
BM-05	1	60K	67.5K	42.5K	40K	40K	250	250	200
				50K	65K	75.5K	100	250	250
				60K	52.5K	80K	150	100	200
"	2	75K	70K	65.5K	60K	65.5K	200	200	200
				45K	60K	75K	150	50	100
				70K	65K	55.5K	100	75	100
BM-06	1	72.5K	75K	40.5K	40.5K	35.5K	100	100	150
				55K	45K	55K	50	150	100
				55K	50K	45.5K	150	100	150
"	2	72.5K	65K	45K	45.5K	50.5K	100	200	150
				45.5K	40K	50K	150	100	150
				55K	50K	60K	150	50	50

(a) Only stations with detectable activity are listed.

TABLE C.3 CONTINUED [a]

Sample Number	Collector Number	Alpha Readings During Recovery (PAC 3G cpm) Left	Right	Alpha Readings Immediately Prior to Removal of Fallout From Collector (PAC 3G cpm)			Alpha Readings Immediately After Removal of Fallout From Collector (PAC 3G cpm)		
BM-07	1	72.5K	75K	40K	20.5K	15K	50	200	250
				35.5K	30K	30K	100	50	200
				55K	35K	30K	150	200	200
"	2	75K	75K	20.5K	30K	35K	400	450	200
				30K	35K	45K	250	200	200
				20.5K	45K	35K	150	200	200
BM-08	1	35K	60K	20.5K	15.5K	15.5K	100	50	50
				30K	15K	15K	50	50	150
				20K	5.5K	10K	100	100	100
"	2	60K	50K	10.5K	10K	10K	100	150	150
				10.5K	10.5K	10K	150	150	150
				5K	10K	10K	200	200	150
BM-09	1	70K	62.5K	15.5K	20K	15.5K	100	100	350
				20K	15.5K	25K	300	200	200
				30K	15K	10K	200	250	100
"	2	65K	60K	15.5K	25K	25.5K	200	250	200
				25K	25K	25.5K	250	200	200
				25K	25K	30K	150	100	200

(a) Only stations with detectable activity are listed.

TABLE C.3 CONTINUED [a]

Sample Number	Collector Number	Alpha Readings During Recovery (PAC 3G cpm) Left	Right	Alpha Readings Immediately Prior to Removal of Fallout From Collector (PAC 3G cpm)			Alpha Readings Immediately After Removal of Fallout From Collector (PAC 3G cpm)		
BM-10	1	70K	70K	20.5K	25K	20K	50	150	100
				25.5K	20.5K	20K	100	200	200
				20.5K	25K	20K	150	100	150
"	2	75K	55K	20.5K	25K	25K	100	150	100
				15.5K	15.5K	20K	50	150	50
				25K	25K	25.5K	250	200	250
BM-11	1	55K	75K	25K	30K	25K	100	100	150
				20K	25K	25K	100	150	200
				25K	35K	25K	150	200	200
"	2	75K	70K	20.5K	30K	25K	200	200	150
				25K	25.5K	25K	150	150	200
				25.5K	30K	25.5K	150	200	150
BO-04	1	200K	100K	100K	95K	95K	50	50	50
				90K	90K	85K	100	200	200
				85K	85K	80.5K	50	175	200
"	2	100K	100K	95K	80K	95.5K	50	50	50
				95K	95.5K	90K	100	100	200
				95K	90K	85.5K	50	100	100

(a) Only stations with detectable activity are listed.

TABLE C.3 CONTINUED [a]

Sample Number	Collector Number	Alpha Readings During Recovery (PAC 3G cpm) Left	Right	Alpha Readings Immediately Prior to Removal of Fallout From Collector (PAC 3G cpm)			Alpha Readings Immediately After Removal of Fallout From Collector (PAC 3G cpm)		
BO-06	1	45K	50K	45K	50K	35.5K	0	75	125
				40K	45.5K	40.2K	0	0	0
				35K	40K	45K	75	100	100
"	2	50K	55K	35.2K	40K	40K	25	0	25
				45.2K	35.5K	35.5K	25	0	25
				45K	40.5K	30K	175	175	100
BO-08	1	45K	50K	20K	35K	35K	25	0	0
				25K	27.5K	32.5K	0	0	25
				15K	12.5K	27.5K	25	0	0
"	2	50K	40K	25K	22.5K	20K	0	0	25
				32.5K	32.5K	20K	75	0	25
				27.5K	25K	15K	0	0	0
BO-10	1	50K	60K	45K	55K	50K	1K	350	700
				40K	55K	50K	600	300	500
				35K	55K	45K	300	250	400
"	2	55K	60K	50K	50K	45K	1K	750	800
				35K	50K	55K	200	250	200
				55K	50K	55K	200	250	300

(a) Only stations with detectable activity are listed.

TABLE C.3 CONTINUED [a]

Sample Number	Collector Number	Alpha Readings During Recovery (PAC 3G cpm) Left	Right	Alpha Readings Immediately Prior to Removal of Fallout From Collector (PAC 3G cpm)			Alpha Readings Immediately After Removal of Fallout From Collector (PAC 3G cpm)		
BO-12	1	25K	20K	20K	20K	20K	50	125	50
				22.5K	20K	25K	50	50	50
				25K	22.5K	20K	100	75	50
"	2	20K	22.5K	20K	20K	20K	50	100	125
				20K	25K	20K	50	100	200
				20K	20K	20K	50	50	50
A-030	1	92K	95K	100K	100K	95K	50	100	50
				90K	100K	100K	100	0	50
				90K	100K	90K	100	100	100
"	2	92K	93K	90Kγ	90K	90K	100	50	200
				90K	90K	90K	200	250	150
				90K	90K	100K	100	150	200
A-040	1	70K	70K	75K	80K	85K	100	50	100
				75K	80K	75K	50	150	100
				70K	80K	80K	150	100	100
"	2	70K	65K	70K	80K	80K	100	150	100
				70K	75K	75K	100	50	50
				70K	75K	70K	150	200	100

(a) Only stations with detectable activity are listed.

TABLE C.3 CONTINUED [a]

Sample Number	Collector Number	Alpha Readings During Recovery (PAC 3G cpm) Left	Right	Alpha Readings Immediately Prior to Removal of Fallout From Collector (PAC 3G cpm)			Alpha Readings Immediately After Removal of Fallout From Collector (PAC 3G cpm)		
A-050	1	50K	47K	50K	60K	75K	400	300	150
				50.5K	60K	60K	200	700	600
				60.5K	50K	60K	300	200	300
"	2	45K	50K	60K	50K	60K	500	600	400
				60K	50.5K	50.5K	350	200	300
				50K	60K	50.5K	200	250	200
A-060	1	30K	32K	30K	30K	30K	50	0	50
				25K	30K	30.5K	50	100	150
				30.5K	30K	30.5K	50	100	150
"	2	30K	32K	40K	30K	30K	50	50	100
				25K	30.5K	30K	150	150	100
				30.5K	30K	30K	50	150	100
A-070	1	15K	15K	20K	20K	25K	100	50	100
				15K	25K	20K	150	100	100
				25K	20.5K	20K	100	150	150
"	2	15K	15K	25K	20K	20K	150	100	150
				20K	15.5K	25K	100	50	100
				20K	20.5K	20K	150	100	50

(a) Only stations with detectable activity are listed.

TABLE C.3 CONTINUED [a]

Sample Number	Collector Number	Alpha Readings During Recovery (PAC 3G cpm) Left	Right	Alpha Readings Immediately Prior to Removal of Fallout From Collector (PAC 3G cpm)			Alpha Readings Immediately After Removal of Fallout From Collector (PAC 3G cpm)		
A-080	1	8K	6K	5K	5.5K	5K	100	150	50
				4.5K	5K	5K	150	50	100
				5.5K	5K	5K	100	100	150
"	2	6K	6.5K	7K	6.5K	7K	50	50	100
				6K	6.5K	5K	150	100	100
				7K	7K	6.5K	50	100	100
A-090	1	7K	7K	7K	7K	7.5K	0	50	50
				7.5K	7K	7K	100	100	50
				6K	7.5K	6.5K	50	50	50
"	2	7K	8K	7K	7K	6.5K	50	100	50
				7K	7.5K	6K	100	100	100
				7K	7K	7.5K	150	100	50
B-030	1	64K	66K	75K	70K	70K	0	50	50
				75K	65K	70K	0	25	100
				70K	65K	65K	25	50	100
"	2	66K	66K	60K	60K	60K	0	25	25
				60K	65K	70K	50	0	25
				70K	60K	60K	75	0	0

(a) Only stations with detectable activity are listed.

TABLE C.3 CONTINUED [a]

Sample Number	Collector Number	Alpha Readings During Recovery (PAC 3G cpm) Left	Right	Alpha Readings Immediately Prior to Removal of Fallout From Collector (PAC 3G cpm)			Alpha Readings Immediately After Removal of Fallout From Collector (PAC 3G cpm)		
B-040	1	31K	30K	30K	30K	30K	50	0	0
				30K	30K	30K	0	0	0
				30K	30K	30K	0	0	50
"	2	31K	30K	25K	20K	25K	50	100	50
				20K	25K	20K	0	0	0
				25K	25K	25K	0	0	50
B-050	1	20K	20K	20K	20K	20K	0	0	0
				20K	20K	20K	25	0	0
				20K	20K	15K	0	0	0
	2	22.5K	22.5K	15K	20K	15K	0	0	25
				15K	15K	15K	0	0	100
				20K	20K	20K	0	0	0
B-060	1	12.5K	15K	17.5K	17.5K	17.5K	0	0	50
				12.5K	15K	17.5K	50	50	50
				12.5K	12.5K	15K	50	50	50
"	2	12.5K	15K	15K	15K	12.5K	50	50	50
				12.5K	12.5K	12.5K	0	0	75
				15K	15K	15K	25	125	75

(a) Only stations with detectable activity are listed.

TABLE C.3 CONTINUED [a]

Sample Number	Collector Number	Alpha Readings During Recovery (PAC 3G cpm) Left	Right	Alpha Readings Immediately Prior to Removal of Fallout From Collector (PAC 3G cpm)			Alpha Readings Immediately After Removal of Fallout From Collector (PAC 3G cpm)		
B-070	1	8K	7.5K	6K	5.5K	7K	0	0	0
				6K	6.5K	7K	0	0	0
				7K	6.5K	7.5K	0	0	50
"	2	8K	7.5K	5K	5K	6K	0	50	100
				6K	5K	6K	0	0	0
				5.5K	6K	7K	0	0	0
B-080	1	4K	4.5K	3.5K	3.5K	3.5K	50	50	50
				4K	3.5K	4K	50	0	25
				4.5K	4K	4K	0	25	0
"	2	5K	4K	3.75K	4K	3K	50	75	50
				3.5K	3.75K	4K	25	50	0
				3.75K	4.25K	4K	50	75	25
B-090	1	3K	2.5K	750	850	375	50	0	0
				850	800	800	0	25	0
				1.25K	1.5K	2.5K	0	25	0
"	2	1.5K	1.5K	2K	2K	2K	25	0	50
				2.5K	2K	2K	0	0	0
				2.5K	1.75K	2.5K	0	0	0

(a) Only stations with detectable activity are listed.

TABLE C.3 CONTINUED [a]

Sample Number	Collector Number	Alpha Readings During Recovery (PAC 3G cpm) Left	Right	Alpha Readings Immediately Prior to Removal of Fallout From Collector (PAC 3G cpm)			Alpha Readings Immediately After Removal of Fallout From Collector (PAC 3G cpm)		
C-030	1	3K	17.5K	20K	20K	25K	75	100	50
				22.5K	20K	20K	200	250	225
				20K	22.5K	22.5K	150	125	125
"	2	3K	27.5K	20K	20K	20K	150	175	150
				20K	22.5K	20K	125	150	100
				20K	22.5K	22.5K	150	200	75
C-040	1	17.5K	17.5K	15K	15K	15K	100	100	50
				15K	12.5K	12.5K	50	50	50
				12.5K	12K	12K	75	100	100
"	2	17.5K	17.5K	12K	15K	12.5K	75	50	50
				15K	10K	12.5K	50	25	100
				12.5K	15K	12.5K	25	50	100
C-050	1	8.5K	8K	7.5K	8K	8K	0	100	50
				8.5K	8K	9K	100	100	50
				10K	8.5K	8K	125	50	25
"	2	8K	7.5K	8K	9K	6.5K	25	0	25
				7.5K	10.5K	7K	25	50	0
				8K	8K	7.5K	25	50	25

(a) Only stations with detectable activity are listed.

TABLE C.3 CONTINUED [a]

Sample Number	Collector Number	Alpha Readings During Recovery (PAC 3G cpm) Left	Right	Alpha Readings Immediately Prior to Removal of Fallout From Collector (PAC 3G cpm)			Alpha Readings Immediately After Removal of Fallout From Collector (PAC 3G cpm)		
C-060	1	7K	6.5K	5.5K	6K	5.75K	50	50	50
				7.5K	6.25K	6.25K	0	0	50
				6.5K	5.75K	7.25K	50	50	0
"	2	7K	7K	5.75K	7.25K	6.75K	0	50	0
				6.75K	6.75K	5.75K	50	0	50
				5.75K	7.25K	6.75K	50	0	100
C-070	1	5.5K	5K	5K	4.5K	4.75K	25	50	50
				5.5K	5.5K	5K	25	50	0
				4.5K	4K	4.5K	0	0	50
"	2	5.25K	5.5K	4K	4.5K	5K	50	50	50
				5K	5K	4.5K	50	50	50
				4K	4.5K	5K	50	75	0
C-080	1	3.75K	3.0K	3K	3K	3.75K	50	75	100
				3.5K	3K	3.5K	50	50	50
				3.5K	3K	3K	50	50	100
"	2	3.5K	3.5K	3.25K	3.25K	3.5K	50	50	100
				3K	3.25K	3.5K	25	50	75
				3.75K	3.5K	3.75K	50	100	75

(a) Only stations with detectable activity are listed.

TABLE C.3 CONTINUED [a]

Sample Number	Collector Number	Alpha Readings During Recovery (PAC 3G cpm) Left	Right	Alpha Readings Immediately Prior to Removal of Fallout From Collector (PAC 3G cpm)			Alpha Readings Immediately After Removal of Fallout From Collector (PAC 3G cpm)		
C-090	1	2.5K	2.5K	2.5K	2.2K	2K	75	50	50
				2K	2K	2.25K	50	50	50
				2K	2.5K	2.75K	50	100	50
"	2	2.5K	2.5K	2.5K	1.5K	2.5K	50	75	25
				2K	2.5K	2.5K	50	50	25
				2.25K	2K	2K	50	0	25
D-030	1	10K	10K	12.5K	10K	12.5K	150	75	0
				10K	10K	12.5K	75	150	50
				12.5K	10K	7.5K	0	100	75
"	2	10K	10K	10K	10K	12.5K	50	100	175
				10K	12.5K	10K	200	100	100
				10K	10K	10K	125	100	100
D-040	1	4.25K	5.25K	6K	6.5K	5K	0	0	0
				6K	6K	6K	0	0	0
				6K	6K	6.5K	0	0	0
"	2	5.5K	6K	6.5K	6K	7.5K	0	75	0
				7K	6K	6.5K	0	0	0
				5K	4.5K	5.5K	0	0	0

(a) Only stations with detectable activity are listed.

TABLE C.3 CONTINUED [a]

Sample Number	Collector Number	Alpha Readings During Recovery (PAC 3G cpm) Left	Right	Alpha Readings Immediately Prior to Removal of Fallout From Collector (PAC 3G cpm)			Alpha Readings Immediately After Removal of Fallout From Collector (PAC 3G cpm)		
D-050	1	4K	4K	3.5K	4K	3.75K	0	0	0
				4K	3K	4K	0	0	0
				3.75K	3.5K	4.5K	0	0	0
"	2	4K	4K	4K	3K	4K	0	0	0
				3.5K	3K	4K	0	0	0
				4K	3.5K	3.5K	0	0	0
D-060	1	3K	3K	3K	2.5K	2.5K	200	0	50
				2K	2.5K	3K	50	0	0
				3.5K	3.75K	4K	0	0	0
"	2	3K	3K	3K	2.5K	3K	0	50	0
				2.5K	2K	2K	0	0	0
				2.5K	2.5K	3K	0	25	0
D-070	1	2.5K	2.75K	2K	2K	2.5K	0	50	0
				2.5K	2.5K	2K	0	0	0
				2.5K	2K	2.5K	0	25	0
"	2	2.25K	2.5K	3K	2K	2.5K	0	0	0
				2K	2.5K	2.25K	0	0	0
				2.5K	2K	2.25K	0	0	0

(a) Only stations with detectable activity are listed.

TABLE C.3 CONTINUED [a]

Sample Number	Collector Number	Alpha Readings During Recovery (PAC 3G cpm) Left	Right	Alpha Readings Immediately Prior to Removal of Fallout From Collector (PAC 3G cpm)			Alpha Readings Immediately After Removal of Fallout From Collector (PAC 3G cpm)		
D-080	1	2K	2K	100	100	100	0	0	0
				100	125	100	0	0	0
				150	150	150	0	0	0
"	2	2K	2K	100	150	200	0	0	0
				100	300	200	0	0	0
				350	300	250	0	0	0
D-090	1	950	950	2K	1.5K	2K	0	25	0
				1.5K	1K	2K	0	0	0
				1.5K	1.5K	1.75K	0	0	0
"	2	950	950	1.75K	1.5K	1.5K	0	0	0
				1.5K	2.5K	2K	0	0	0
				1.5K	1.5K	1.75K	25	25	0
F-030	1	6.5K	6K	9.5K	7.5K	7.75K	50	0	100
				8.5K	7.75K	8.25K	100	0	100
				8K	7.25K	8K	50	25	25
	2	6.5K	6.5K	6.5K	7.5K	8.5K	125	100	150
				8.5K	7.5K	8.25K	100	50	100
				6.5K	7.25K	7.25K	150	150	100

(a) Only stations with detectable activity are listed.

TABLE C.3 CONTINUED [a]

Sample Number	Collector Number	Alpha Readings During Recovery (PAC 3G cpm) Left	Right	Alpha Readings Immediately Prior to Removal of Fallout From Collector (PAC 3G cpm)			Alpha Readings Immediately After Removal of Fallout From Collector (PAC 3G cpm)		
F-040	1	2K	2.5K	2.5K	2K	3K	0	0	0
				2K	2.5K	3K	0	0	0
				3K	4K	4.5K	0	75	50
"	2	2K	3K	2K	2K	3.5K	0	0	50
				2.5K	2.5K	3.5K	0	25	0
				2.5K	2.5K	3K	25	0	50
F-050	1	750	750	1K	1K	1K	50	0	0
				1K	1K	1.5K	50	25	0
				1.5K	1K	1K	0	5	0
"	2	650	700	1K	1K	1K	25	0	5
				1.5K	1K	1K	75	75	75
				1.5K	1K	1K	100	75	50
F-060	1	750	750	150	175	250	0	0	25
				175	300	350	0	0	0
				300	350	325	25	50	0
"	2	650	650	225	375	275	0	0	0
				350	475	550	25	50	50
				600	600	625	0	50	50

(a) Only stations with detectable activity are listed.

TABLE C.3 CONTINUED [a]

Sample Number	Collector Number	Alpha Readings During Recovery (PAC 3G cpm) Left	Right	Alpha Readings Immediately Prior to Removal of Fallout From Collector (PAC 3G cpm)			Alpha Readings Immediately After Removal of Fallout From Collector (PAC 3G cpm)		
F-070	1	500	550	200	200	175			
				175	250	250	Sample spilled after monitoring data was taken		
				275	400	500			
"	2	450	450	400	300	500			
				450	425	325			
				550	400	375			
F-080	1	No Reading Taken		350	250	350	0	0	0
				200	225	300	0	0	0
				350	325	200	0	0	0
"	2	No Reading Taken		300	300	300	0	0	0
				450	400	425	0	0	0
				375	425	475	0	0	0
F-090	1	250	200	300	550	300	0	0	0
				200	450	450	0	0	0
				300	500	350	0	0	25
"	2	200	200	200	200	350	25	25	50
				400	300	350	0	0	0
				450	400	300	0	0	0

(a) Only stations with detectable activity are listed.

TABLE C.3 CONTINUED [a]

Sample Number	Collector Number	Alpha Readings During Recovery (PAC 3G cpm) Left	Right	Alpha Readings Immediately Prior to Removal of Fallout From Collector (PAC 3G cpm)			Alpha Readings Immediately After Removal of Fallout From Collector (PAC 3G cpm)		
H-030	1	3K	2.5K	2.5K	4K	3.75K	50	75	50
				3.5K	3.5K	3K	0	0	0
				3.25K	3K	3K	50	50	50
"	2	3.5K	3K	3K	4.25K	3.25K	100	100	100
				3.25K	3.25K	3.75K	50	50	100
				3.25K	3.5K	4K	100	50	100
H-040	1	2K	850	1K	1K	4.5K	50	50	50
				1K	1.5K	1K	100	100	50
				1K	1K	1.5K	100	50	100
"	2	2K	850	1.5K	1K	1.5K	100	100	100
				1.5K	1K	1K	50	50	100
				5K	1.5K	1K	100	100	100
H-050	1	400	550	600	600	800	50	0	0
				800	800	700	50	0	0
				700	700	800	0	50	0
"	2	500	500	600	700	700	50	50	0
				600	800	800	50	0	50
				700	700	800	0	100	50

(a) Only stations with detectable activity are listed.

TABLE C.3 CONTINUED [a]

Sample Number	Collector Number	Alpha Readings During Recovery (PAC 3G cpm) Left	Right	Alpha Readings Immediately Prior to Removal of Fallout From Collector (PAC 3G cpm)			Alpha Readings Immediately After Removal of Fallout From Collector (PAC 3G cpm)		
H-060	1	400	400	600	800	800	150	150	150
				700	800	600	50	50	50
				600	700	500	50	100	50
"	2	450	500	500	600	700	50	50	100
				600	600	700	100	100	150
				600	500	600	50	50	100
H-070	1	400	300	250	300	400	50	50	100
				250	300	500	100	100	50
				400	300	300	50	50	50
"	2	350	300	400	400	450	50	50	50
				300	600	500	100	100	50
				400	450	300	50	100	100
H-080	1	300	300	200	250	400	50	50	100
				400	400	500	100	50	100
				400	200	700	100	100	100
"	2	300	350	500	500	600	50	50	50
				500	550	500	100	100	50
				600	500	500	100	50	100
H-090	1	250	250	800	600	700	50	100	100
				750	500	500	00	50	100
				500	500	400	50	100	100
"	2	250	250	500	600	700	50	50	100
				600	500	600	00	100	100
				600	600	700	50	100	100

(a) Only stations with detectable activity are listed.

APPENDIX D

MASS, GAMMA ACTIVITY, AND PLUTONIUM CONTENT OF FALLOUT SAMPLES

Each fallout sample was weighed and its plutonium content was determined from its count rate as detected in a well-type, NaI crystal. The data reported in Tables D.1 through D.3 have been corrected for self-absorption and sample geometry.

The mass of plutonium and of fallout deposited per square meter are also reported.

TABLE D.1 TOTAL MASS, GAMMA ACTIVITY, AND PLUTONIUM CONTENT OF DOUBLE TRACKS FALLOUT SAMPLES

Sample Number	Well Crystal Activity (cpm)(1)	Mass of Pu Per Sample (μg)	Mass of Pu Per Unit Area (μg/m^2) (3)	Total Mass of Material Collected (grams)	Mass of Material Per Unit Area (g/m^2)
AH 05	239,100	291	98	12.5	4.21
AH 06	1,874,000(2)	2342	788	19.5	6.56
AH 07	1,794,000(2)	2242	755	15.0	5.05
AJ 04	11,800	13	4	4.52	1.52
AJ 05	28,000	34	11	4.58	1.59
AJ 06	275,000	335	112	6.00	2.02
AJ 07	2,919,000(2)	3317	1116	4.50	1.52
AJ 08	51,300	62	21	3.05	1.28
BK 07	4,900	6	2	3.95	1.33
BK 08	12,200	15	5	3.02	1.18
BK 09	192,900	224	75	3.15	1.06
BL 07	3,510	4	1	2.45	0.82
BL 08	23,800	26	9	2.25	0.78
BL 09	570,000	662	223	3.58	1.21
BM 08	12,800	14	5	2.40	0.81
BM 09	1,047,000(2)	1189	400	3.32	1.12
BO 10	61,000	68	23	1.45	0.49
A 060	17,000	19	6	1.05	0.35
A 070	886,500	1007	339	1.30	0.44
A 080	1,300	1.5	0.5	0.81	0.27
B 050	24,200	27	4	3.81	0.64
B 060	44,200	49	8	2.83	0.48
B 070	262,000	291	49	3.36	0.56
C 050	51,000	56	9	3.52	0.59
C 060	156,700	174	29	4.81	0.81
C 070	65,500	73	12	3.88	0.65
D 050	327,500	364	61	1.52	0.25
D 060	127,500	142	24	2.33	0.39
D 070	41,200	46	8	1.07	0.18

(1) Average of two 1-minute counts normalized to the counter response at NRDL.

(2) The sample was split into two or more fractions and the total activity was determined from the sum of the activities of the fractions.

(3) Four, instead of the usual two, aluminum collectors were exposed at each station on Arcs B, C, and D.

TABLE D.2 TOTAL MASS, GAMMA ACTIVITY, AND PLUTONIUM CONTENT OF CLEAN SLATE I FALLOUT SAMPLES

Sample Number	Well Crystal Activity (cpm)(1)	Mass of Pu Per Sample (μg)	Mass of Pu Per Unit Area (μg/m²)	Total Mass of Material Collected (grams)	Mass of Material Per Unit Area (g/m²)
AH 06	2,984,000(2)	3826	1288	46.89	15.78
AH 07	3,145,000(2)	4032	1357	86.58	29.15
AJ 04	1,269,000(2)	1626	547	53.72	18.09
AJ 05	4,733,000(2)	6067	2042	69.08	23.26
AJ 06	2,183,000(2)	2799	942	84.478	28.44
AJ 07	1,802,000(2)	2310	777	47.56	16.01
AJ 08	42,000	54	18	58.58	19.72
BK 05	13,000	17	5.7	10.38	3.50
BK 06	274,300	351	118	12.42	4.18
BK 07	3,386,000(2)	4341	1461	37.57	12.65
BK 08	3,097,000(2)	3445	1165	21.48	7.24
BK 09	242,100	310	104	27.45	9.24
BL 05	18,800	24	8	7.05	2.37
BL 06	859,300	1100	370	8.03	2.70
BL 07	2,101,000(2)	2693	906	11.192	3.76
BL 08	1,175,000(2)	1506	507	6.0206	2.03
BL 09	136,100	174	58	6.60	2.22
BM 05	226,600	276	93	3.20	1.07
BM 06	2,869,000(2)	3678	1238	13.611	4.59
BM 07	682,800	833	280	4.28	1.44
BM 08	329,900	423	142	6.60	2.22
BM 09	34,500	44	14	6.42	2.16
BO 04	321,400	392	132	2.69	0.91
BO 06	694,900(2)	847	285	2.7738	0.93
BO 08	43,500	53	18	3.20	1.08
A 020	430,900	501	168	1.1442	0.385
A 030	629,000(2)	[illegible]	271	1.1901	0.401
A 040	75,700	84	28	0.7213	0.243
A 050	14,700	17	5.7	0.7331	0.247
A 060	6,700	7.4	2.5	0.8284	0.279

TABLE D.2 CONTINUED

Sample Number	Well Crystal Activity (cpm)(1)	Mass of Pu Per Sample (μg)	Mass of Pu Per Unit Area (μg/m²)	Total Mass of Material Collected (grams)	Mass of Material Per Unit Area (g/m²)
B 020	167,300(2)	194	65	1.1462	0.3858
B 030	258,600(2)	300	101	1.2478	0.4195
B 040	25,100	29	9.7	1.7661	0.5946
B 050	7,700	8.9	3.0	1.7669	0.5949
C 020	73,600	90	30	3.60	1.21
C 030	269,500(2)	328	110	3.3994	1.14
D 030	340,400(2)	415	140	2.6894	0.906
F 030	292,300(2)	340	114	1.8269	0.615
H 030	269,400(2)	328	110	2.2004	0.741

(1) Average of two 1-minute counts normalized to the counter response at NRDL.

(2) The sample was split into two or more fractions and the total activity was determined from the sum of the activities of the fractions.

TABLE D.3 TOTAL MASS, GAMMA ACTIVITY, AND PLUTONIUM CONTENT OF CLEAN SLATE II FALLOUT SAMPLES

Sample Number	Well Crystal Activity (cpm)[1]	Mass of Pu Per Sample (μg)	Mass of Pu Per Unit Area (μg/m²)	Total Mass of Material Collected (grams)	Mass of Material Per Unit Area (g/m²)
AJ 04 (a)	3,631,000[2]	4655	1567	4,545	1,520
AJ 04(b)	269,800	346	116	71.20	24
AJ 07(a)	10,720,000[2]	13874	4671	7,601	2,559
AJ 07(b)	322,000	412	138	85.08	29
AJ 08(a)	2,583,000[2]	3311	1114	760.9	256
AJ 08(b)	900,900	1150	387	136.11	46
BK 07(a)	4,279,000[2]	5485	1846	3,838.4	1,292
BK 07(b)	290,500	372	126	68.85	23
BK 09(a)	1,362,000[2]	1746	587	737.3	147
BK 09(b)	762,800	977	329	127.13	43
BK 10(a)	1,255,000[2]	1609	541	283.6	95
BK 10(b)	1,327,000	701	570	197.21	66
BL 06(a)	4,683,000[2]	5747	1924	1,936.8	652
BL 06(b)	446,700	572	192	60.8	20
BL 08(a)	1,445,000[2]	1852	623	3,025.1	1,018
BL 08(b)	274,400	351	118	74.6	25
BL 09(a)	865,300	1109	373	598.4	201
BL 09(b)	415,200	532	179	113.32	38
BL 10(a)	1,837,000[2]	2355	793	464.8	155
BL 10(b)	648,700	831	280	113.23	38
BM 05(a)	3,577,000[2]	3622	1220	1,281.2	431
BM 05(b)	455,200	461	155	64.8	22
BM 06(a)	4,757,000[2]	4820	1622	1,352.5	455
BM 06(b)	505,200	512	172	70.84	24
BM 07(a)	1,774,000[2]	1797	605	1,186.2	399
BM 07(b)	310,600	315	106	58.00	19
BM 08(a)	2,908,000[2]	2945	991	3,249.6	1,094
BM 08(b)	178,300	180	61	63.24	21
BM 09(a)	1,040,000[2]	1054	355	404.6	136
BM 09(b)	323,700	328	110	76.3	26
BM 10(a)	797,900	807	27	309.4	104
BM 10(b)	438,200	444	149	109.4	37
BM 11(a)	781,200	791	266	229.3	77
BM 11(b)	1,247,000[2]	1263	425	136.25	46

TABLE D.3 CONTINUED

Sample Number	Well Crystal Activity (cpm)[1]	Mass of Pu Per Sample (μg)	Mass of Pu Per Unit Area ($\mu g/m^2$)	Total Mass of Material Collected (grams)	Mass of Material Per Unit Area (g/m^2)
B0 04(a)	7,108,000[2]	7198	2424	858.3	289
B0 04(b)	2,021,000[2]	2047	689	Spilled before weighing	
B0 06(a)	593,200	601	202	321.1	108
B0 06(b)	475,500	482	162	60.20	20
B0 08(a)	384,400	389	131	530.2	178
B0 08(b)	297,900	302	102	70.005	23
B0 10(a)	384,400	389	131	12.9	4
B0 10(b)	477,400	483	163	98.88	33
B0 12	241,100	244	82	91.95	31
A 030(a)	1,102,000[2]	1412	476	137.2	46
A 030(b)	1,128,000[2]	1446	487	68.57	23
A 040(a)	365,300	468	158	68.4	23
A 040(b)	904,800	1040	351	76.29	26
A 050	276,100	354	119	90.8	31
A 060	446,000	572	193	90.75	30
A 070	250,800	321	108	51.83	17
A 080	120,300	134	45	41.26	14
A 090	58,410	75	25	13.7951	4.6
B 030	955,000	1224	413	59.45	20
B 040	308,200	395	133	27.9	9.4
B 050	196,600	252	85	16.05	5.4
B 060	119,400	139	47	8.9013	3.0
B 070	70,650	90	30	5.7095	1.9
B 080	30,760	37	12	3.7914	1.3
B 090	20,470	25	8	4.374	1.5
C 030	269,900	346	116	15.1360	5.1
C 040	149,800	192	65	9.2329	3.1
C 050	105,700	135	45	7.3642	2.5
C 060	83,600	105	35	7.1104	2.4
C 070	41,590	53	18	6.7352	2.3
C 080	26,440	34	11	6.6960	2.3
C 090	16,250	20	7	4.3312	1.5

TABLE D.3 CONTINUED

Sample Number	Well Crystal Activity (cpm)(1)	Mass of Pu Per Sample (μg)	Mass of Pu Per Unit Area (μg/m²)	Total Mass of Material Collected (grams)	Mass of Material Per Unit Area (g/m²)
D 030	163,800	210	71	8.520	2.87
D 040	72,230	88	30	4.0031	1.35
D 050	51,570	63	21	2.7217	0.91
D 060	38,440	48	16	2.1410	0.72
D 070	24,270	28	9	1.5510	0.52
D 080	30,760	38	13	1.6076	0.54
D 090	16,090	19	6	1.5529	0.52
F 030	151,700	194	65	9.3694	3.15
F 040	62,770	80	27	8.9788	3.02
F 050	14,050	16	5.4	1.2090	0.41
F 060	12,350	14	4.7	1.0032	0.34
F 070	10,460	13	4.4	0.9234	0.31
F 080	9,690	12	4.0	2.0194	0.68
F 090	7,880	9	3.0	0.8818	0.30
H 030	33,650	41	14	2.8909	0.97
H 040	25,200	31	10	3.3842	1.14
H 050	32,090	39	13	2.0768	0.70
H 060	24,800	29	9.7	2.7830	0.93
H 070	14,060	17	5.7	2.1698	0.73
H 080	11,030	13	4.4	3.0755	1.03
H 090	12,180	15	5.1	3.1440	1.06

(a) Throwout material that slid from aluminum collector when it was tipped vertically.
(b) Material that adhered to petrolatum surface of aluminum collector after collector had been tipped vertically.

(1) Each value is an average of two 1-minute counts.
(2) Activity of total sample was calculated from one or more aliquots.

APPENDIX E

DISTRIBUTION OF MASS AND GAMMA ACTIVITY AMONG DRY-SIEVED PARTICLE-SIZE FRACTIONS OF FALLOUT SAMPLES

Fallout samples were dry-sieved and each sieved fraction was weighed and gamma counted. The percent of the weight and gamma activity retained by each sieve fraction and the cumulative percent less than the stated sieve size are tabulated and displayed graphically in Figures E.1 through E.3.

The gamma activity data (Tables E.1 through E.3) were taken at TTR and were neither normalized nor corrected by the factors in Section 3.3.

TABLE E.1 DISTRIBUTION OF MASS AND GAMMA ACTIVITY AMONG DRY-SIEVED PARTICLE-SIZE FRACTIONS OF DOUBLE TRACKS FALLOUT SAMPLES

DT Sample AH-06

Tyler Mesh	Sieve Opening (microns)	Mass Retained (grams)	Percent of Mass Retained	Cumulative Percent of Mass Less Than Stated Size	Gamma Activity (cpm)	Percent of Activity Retained	Cumulative Percent of Activity Less Than Stated Size
24	710	0.3651	1.86	98.10	14,655	0.97	99.05
42	350	1.1875	6.08	92.02	148,856	9.84	89.21
65	210	2.0727	10.61	81.41	257,765	17.03	72.18
100	149	2.6089	13.35	68.06	174,117	11.51	60.67
150	105	2.4418	12.50	55.56	122,238	8.08	52.59
200	74	3.3139	16.96	38.60	109,082	7.21	45.38
325	44	4.4220	22.64	15.96	99,372	6.58	38.80
Pan	(- 44)	3.1173	15.96		587,047	38.80	
Total		19.5292	99.96		1,513,100	100.02	

Orig. Wt. 19.5 g

DT Sample AH-07

Tyler Mesh	Sieve Opening (microns)	Mass Retained (grams)	Percent of Mass Retained	Cumulative Percent of Mass Less Than Stated Size	Gamma Activity (cpm)	Percent of Activity Retained	Cumulative Percent of Activity Less Than Stated Size
24	710	0.2342	1.54	98.45	1,026,937	29.97	70.07
42	350	0.7129	4.69	93.76	96,771	2.82	67.25
65	210	1.2623	8.30	85.46	15,336	.45	66.80
100	149	1.6822	11.06	74.40	20,263	.59	66.21
150	105	1.7466	11.48	62.92	456,182	13.31	52.90
200	74	2.4885	16.36	46.56	651,819	19.02	33.88
325	44	3.8975	25.63	20.93	1,022,496	29.84	4.04
Pan	(- 44)	3.1830	20.93		138,283	4.04	
Total		15.2072	99.99		3,427,087	100.04	

Orig. Wt. 15.0 g

TABLE E.1 CONTINUED

DT Sample AJ-07

Tyler Mesh	Sieve Opening (microns)	Mass Retained (grams)	Percent of Mass Retained	Cumulative Percent of Mass Less Than Stated Size	Gamma Activity (cpm)	Percent of Activity Retained	Cumulative Percent of Activity Less Than Stated Size
24	710	0.0633	1.39	98.58	1,424	0.05	99.95
42	350	0.2194	4.83	93.75	251,139	9.49	90.46
65	210	0.2808	6.19	87.56	1,106,261	41.81	48.65
100	149	0.2130	4.69	82.87	618,613	23.38	25.27
150	105	0.2039	4.49	78.38	196,772	7.44	17.83
200	74	0.3728	8.22	70.16	120,411	4.55	13.28
325	44	0.9821	21.65	48.51	94,562	3.57	9.71
Pan	(- 44)	2.2000	48.51		256,823	9.71	
Total		4.5353	99.97		2,646,005	100.00	

Orig. Wt. 4.50 g

DT Sample BK-09

Tyler Mesh	Sieve Opening (microns)	Mass Retained (grams)	Percent of Mass Retained	Cumulative Percent of Mass Less Than Stated Size	Gamma Activity (cpm)	Percent of Activity Retained	Cumulative Percent of Activity Less Than Stated Size
24	710	0.0466	1.48	99.12	1,050	0.57	99.45
42	350	0.0482	1.53	97.59	53,221	28.75	70.70
65	210	0.0885	2.82	94.77	91,670	49.52	21.18
100	149	0.1278	4.70	90.07	11,634	6.28	14.90
150	105	0.1892	6.03	84.04	2,395	1.29	13.61
200	74	0.4049	12.90	71.14	3,855	2.08	11.53
325	44	0.9086	28.96	42.18	4,229	2.28	9.25
Pan	(- 44)	1.3235	42.18		17,129	9.25	
Total		3.1373	100.60		185,180	100.02	

Orig. Wt. 3.15 g

TABLE E.1 CONTINUED

DT Sample BL-09

Tyler Mesh	Sieve Opening (microns)	Mass Retained (grams)	Percent of Mass Retained	Cumulative Percent of Mass Less Than Stated Size	Gamma Activity (cpm)	Percent of Activity Retained	Cumulative Percent of Activity Less Than Stated Size
24	710	0.0604	1.59	98.39	198	0.04	99.96
42	350	0.1651	4.34	94.05	57,752	10.26	89.70
65	210	0.2977	7.84	86.21	305,096	54.20	35.50
100	149	0.3566	9.39	76.82	100,848	17.92	17.58
150	105	0.3720	9.79	67.03	17,087	3.03	14.55
200	74	0.5239	13.80	53.23	30,265	5.38	9.17
325	44	0.9126	24.04	29.19	12,585	2.23	6.94
Pan	(- 44)	1.1082	29.19		39,051	6.94	
Total		3.7965	99.98		562,882	100.00	

Orig. Wt. 3.58 g

DT Sample BM-09

Tyler Mesh	Sieve Opening (microns)	Mass Retained (grams)	Percent of Mass Retained	Cumulative Percent of Mass Less Than Stated Size	Gamma Activity (cpm)	Percent of Activity Retained	Cumulative Percent of Activity Less Than Stated Size
24	710	0.0044	0.13	99.83	Bkg	-	99.99
42	350	0.0539	1.65	98.18	56,953	5.27	94.72
65	210	0.1710	5.24	92.94	433,239	40.11	54.61
100	149	0.1617	4.95	87.99	342,525	31.71	22.90
150	105	0.1987	6.09	81.90	76,302	7.06	15.84
200	74	0.4008	12.28	69.62	43,775	4.05	11.79
325	44	0.8588	26.32	43.30	32,684	3.02	8.77
Pan	(- 44)	1.4127	43.30		94,749	8.77	
Total		3.2620	99.96		1,080,227	99.99	

Orig. Wt. 3.32 g

TABLE E.1 CONTINUED

DT Sample A-70

Tyler Mesh	Sieve Opening (microns)	Mass Retained (grams)	Percent of Mass Retained	Cumulative Percent of Mass Less Than Stated Size	Gamma Activity (cpm)	Percent of Activity Retained	Cumulative Percent of Activity Less Than Stated Size
24	710	0.0026	0.20	99.25	156	0.02	99.97
42	350	0.0120	0.42	98.83	1,584	0.53	99.44
65	210	0.0671	5.17	93.66	161,133	18.71	80.73
100	149	0.1117	8.61	85.05	308,507	35.82	44.91
150	105	0.1153	8.88	76.17	158,972	18.46	26.45
200	74	0.1879	14.48	61.69	86,247	10.01	16.44
325	44	0.3557	27.42	34.27	60,118	6.98	9.46
Pan	(- 44)	0.4446	34.27		81,488	9.46	
Total		1.2969	99.45		861,205	99.99	

Orig. Wt. 1.30 g

DT Sample B-070

Tyler Mesh	Sieve Opening (microns)	Mass Retained (grams)	Percent of Mass Retained	Cumulative Percent of Mass Less Than Stated Size	Gamma Activity (cpm)	Percent of Activity Retained	Cumulative Percent of Activity Less Than Stated Size
24	710	0.040	1.34	98.63	9,825	4.17	95.82
42	350	0.020	0.67	97.96	1,430	0.60	95.22
65	210	0.040	1.34	96.62	1,270	0.54	94.68
100	149	0.150	5.03	91.59	2,010	0.85	93.83
150	105	0.310	10.40	81.19	18,450	7.84	85.99
200	74	0.520	17.44	63.75	55,444	23.56	62.43
325	44	0.980	32.88	30.87	110,700	47.05	15.38
Pan	(- 44)	0.920	30.87		36,200	15.38	
Total		2.980	99.97		235,300	99.99	

Orig Wt. 3.36 g

TABLE E.1 CONTINUED

DT Sample C-060

Tyler Mesh	Sieve Opening (microns)	Mass Retained (grams)	Percent of Mass Retained	Cumulative Percent of Mass Less Than Stated Size	Gamma Activity (cpm)	Percent of Activity Retained	Cumulative Percent of Activity Less Than Stated Size
24	710	0.0015	0.03	99.93	113	0.07	99.91
42	350	0.1191	2.49	97.44	183	0.11	99.80
65	210	0.3780	7.92	89.52	985	0.62	99.18
100	149	0.4570	9.58	79.94	13,697	8.62	90.56
150	105	0.4313	9.04	70.90	30,268	19.05	71.51
200	74	0.6123	12.83	58.07	37,165	23.39	48.12
325	44	0.9536	19.99	38.08	46,887	29.51	18.61
Pan	(- 44)	1.8161	38.08		29,574	18.61	
Total		4.7689	99.96		158,872	99.98	

Orig. Wt. 4.81 g

DT Sample C-070

Tyler Mesh	Sieve Opening (microns)	Mass Retained (grams)	Percent of Mass Retained	Cumulative Percent of Mass Less Than Stated Size	Gamma Activity (cpm)	Percent of Activity Retained	Cumulative Percent of Activity Less Than Stated Size
24	710	0.0512	1.32	98.64	80	0.14	99.86
42	350	0.0866	2.23	96.41	183	0.32	99.54
65	210	0.0888	2.30	94.11	138	0.24	99.30
100	149	0.1275	3.30	90.81	265	0.46	98.84
150	105	0.1535	3.98	86.83	Bkg	- -	98.84
200	74	0.3301	8.56	78.27	143	1.81	97.03
325	44	0.7983	20.71	57.56	14,485	25.09	71.94
Pan	(- 44)	2.2181	57.56		41.527	71.94	
Total		3.8535	99.96		57.720	100.00	

Orig. Wt. 3.88 g

TABLE E.1 CONTINUED

DT Sample C-050

Tyler Mesh	Sieve Opening (microns)	Mass Retained (grams)	Percent of Mass Retained	Cumulative Percent of Mass Less Than Stated Size	Gamma Activity (cpm)	Percent of Activity Retained	Cumulative Percent of Activity Less Than Stated Size
24	710	0.1214	8.16	91.83	542	0.18	99.83
42	350	0.2492	16.76	75.07	883	0.29	99.54
65	210	0.1097	7.38	67.69	4601	1.51	98.03
100	149	0.0678	4.56	63.13	37,995	12.46	85.57
150	105	0.0651	4.38	58.75	66,125	21.68	63.89
200	74	0.1053	7.08	51.67	84,693	27.77	36.12
325	44	0.2219	14.93	36.74	54,907	18.00	18.12
Pan	(- 44)	0.5461	36.74		55,267	18.12	
Total		1.4865	99.99		305,013	100.01	

Orig. Wt. 1.52 g

DT Sample D-060

Tyler Mesh	Sieve Opening (microns)	Mass Retained (grams)	Percent of Mass Retained	Cumulative Percent of Mass Less Than Stated Size	Gamma Activity (cpm)	Percent of Activity Retained	Cumulative Percent of Activity Less Than Stated Size
24	710	0.0490	2.12	97.83	160	0.14	99.91
42	350	0.1208	5.24	92.59	235	0.20	99.71
65	210	0.0792	3.43	89.16	613	0.53	99.18
100	149	0.0879	3.81	85.35	1,490	1.29	97.89
150	105	0.1157	5.02	80.33	13,198	11.45	86.44
200	74	0.2360	10.24	70.09	28,959	25.12	61.32
325	44	0.6273	27.22	42.87	42,841	37.16	24.16
Pan	(- 44)	0.9878	42.87		27,855	24.16	
Total		2.3037	99.95		115,400	100.05	

Orig. Wt. 2.33 g

TABLE E.1 CONTINUED

DT Sample D-070

Tyler Mesh	Sieve Opening (microns)	Mass Retained (grams)	Percent of Mass Retained	Cumulative Percent of Mass Less Than Stated Size	Gamma Activity (cpm)	Percent of Activity Retained	Cumulative Percent of Activity Less Than Stated Size
24	710	0.0200	2.21	97.76	96	0.29	99.71
42	350	0.0536	5.94	91.82	390	1.19	98.52
65	210	0.0625	6.93	84.89	347	1.06	97.46
100	149	0.0500	5.54	79.35	860	2.62	94.84
150	105	0.0662	7.34	72.01	404	1.23	93.61
200	74	0.0388	4.30	67.71	256	0.78	92.83
325	44	0.2467	27.36	40.35	3,968	12.10	80.73
Pan	(- 44)	0.3638	40.35		26,480	80.73	
Total		0.9016	99.97		32,800	100.00	

Orig. Wt. 1.07 g

TABLE E.2 DISTRIBUTION OF MASS AND GAMMA ACTIVITY AMONG DRY-SIEVED PARTICLE-SIZE FRACTIONS OF CLEAN SLATE I FALLOUT SAMPLES

CS I Sample AH-06

Tyler Mesh	Sieve Opening (microns)	Mass Retained (grams)	Percent of Mass Retained	Cumulative Percent of Mass Less Than Stated Size	Gamma Activity (cpm)	Percent of Activity Retained	Cumulative Percent of Activity Less than Stated Size
24	710	10.1250	21.97	78.22	1,507,688	50.52	49.46
42	350	3.5485	7.64	70.58	1,045,905	35.05	14.41
65	210	0.8359	1.80	68.78	122,210	4.09	10.32
100	149	0.6703	1.44	67.34	53,505	1.79	8.53
150	105	1.7966	3.87	63.47	37,447	1.25	7.28
200	74	2.0571	4.43	59.04	41,355	1.38	5.90
325	44	6.9319	14.92	44.12	54,414	1.82	4.08
Pan	(- 44)	20.5050	44.12		121,829	4.08	
Total		46.4703	100.01		2,984,353	99.98	

Orig. Wt. 46.890

CS I Sample AJ-06

Tyler Mesh	Sieve Opening (microns)	Mass Retained (grams)	Percent of Mass Retained	Cumulative Percent of Mass Less Than Stated Size	Gamma Activity (cpm)	Percent of Activity Retained	Cumulative Percent of Activity Less Than Stated Size
24	710	8.2[illegible]2	9.77	90.24	299,202	15.08	84.90
42	350	15.4[illegible]50	18.40	71.84	1,194,398	60.18	24.72
65	210	7.3500	8.73	63.11	105,163	5.30	19.42
100	149	6.9300	8.23	54.88	86,935	4.38	15.04
150	105	6.5690	7.80	47.08	48,706	2.45	12.59
200	74	16.3800	19.45	27.63	73,060	3.68	8.91
325	44	15,1500	17.99	9.64	92,190	4.64	4.27
Pan	(- 44)	8.1200	9.64		84,800	4.27	
Total		84.2232	101.01		1,984,454	99.98	

Orig. Wt. 84.478 g

TABLE E.2 CONTINUED

CS I Sample BK-08

Tyler Mesh	Sieve Opening (microns)	Mass Retained (grams)	Percent of Mass Retained	Cumulative Percent of Mass Less Than Stated Size	Gamma Activity (cpm)	Percent of Activity Retained	Cumulative Percent of Activity Less Than Stated Size
24	710	0.8842	4.30	95.78	28,324	1.00	99.00
42	350	2.8677	13.94	81.84	1,212,007	42.64	56.36
65	210	2.8563	13.88	67.96	1,225,975	43.14	13.22
100	149	1.4730	7.16	60.80	226,823	7.98	5.24
150	105	1.5640	7.60	53.20	38,560	1.36	3.88
200	74	2.8342	13.78	39.33	23,032	0.81	3.07
325	44	2.6610	12.93	26.40	27,891	0.98	2.09
Pan	(- 44)	5.4320	26.40		59,490	2.09	
Total		20.5724	99.99		2,842,102	100.00	

Orig. Wt. 21.480 g

CS I Sample BL-07

Tyler Mesh	Sieve Opening (microns)	Mass Retained (grams)	Percent of Mass Retained	Cumulative Percent of Mass Less Than Stated Size	Gamma Activity (cpm)	Percent of Activity Retained	Cumulative Percent of Activity Less Than Stated Size
24	710	0.2956	2.67	97.34	51,507	2.69	97.20
42	350	1.9420	17.53	79.81	852,362	44.40	52.80
65	210	1.2903	11.65	68.16	667,431	34.83	17.97
100	149	0.4420	3.99	64.17	199,444	10.41	7.56
150	105	0.4300	3.88	60.29	27,879	1.45	6.11
200	74	0.7896	7.13	53.16	21,109	1.10	5.01
325	44	1.8507	16.71	36.45	26,271	1.37	3.64
Pan	(- 44)	4.0381	36.45		69,733	3.64	
Total		11.0783	100.01		1,915,736	99.89	

Orig. Wt. 11.192 g

TABLE E.2 CONTINUED

CS I Sample BM-06

Tyler Mesh	Sieve Opening (microns)	Mass Retained (grams)	Percent of Mass Retained	Cumulative Percent of Mass Less Than Stated Size	Gamma Activity (cpm)	Percent of Activity Retained	Cumulative Percent of Activity I - Than Stated Size
24	710	2.4487	18.09	81.86	584,672	18.31	81.79
42	350	5.7269	42.30	39.56	1,705,132	53.37	28.42
65	210	1.3619	10.06	29.50	626,896	19.63	8.79
100	149	0.2012	1.44	28.06	68,144	2.13	6.66
150	105	0.2157	1.59	26.47	22,477	0.70	5.96
200	74	0.4252	3.14	23.33	24,567	0.77	5.19
325	44	0.9540	7.05	16.28	35,014	1.10	4.09
Pan	(- 44)	2.2042	16.28		130,510	4.09	
Total		13.5378	99.95		3,193,412	100.00	

Orig. Wt. 13.611 g

CS I Sample BO-06

Tyler Mesh	Sieve Opening (microns)	Mass Retained (grams)	Percent of Mass Retained	Cumulative Percent of Mass Less Than Stated Size	Gamma Activity (cpm)	Percent of Activity Retained	Cumulative Percent of Activity Less Than Stated Size
24	710	0.0227	0.83	99.19	5,415	0.86	99.16
42	350	0.0724	2.65	96.54	39,603	6.30	92.86
65	210	0.4409	16.14	80.40	307,513	48.67	44.17
100	149	0.2873	10.54	69.86	189,240	29.95	14.22
150	105	0.1687	6.17	63.69	47,993	7.60	6.62
200	74	0.2936	10.75	52.94	12,324	1.95	4.67
325	44	0.5206	19.06	33.88	5,529	0.87	3.80
Pan	(- 44)	0.9254	33.88		23,994	3.80	
Total		2.7316	100.00		631,811	100.00	

Orig. Wt. 2.7738 g

TABLE E.2 CONTINUED

CS I Sample A-030

Tyler Mesh	Sieve Opening (microns)	Mass Retained (grams)	Percent of Mass Retained	Cumulative Percent of Mass Less Than Stated Size	Gamma Activity (cpm)	Percent of Activity Retained	Cumulative Percent of Activity Less Than Stated Size
24	710	0.0339	3.05	96.95	8,696	1.38	98.61
42	350	0.2441	21.98	74.97	116,340	18.50	80.11
65	210	0.2843	25.60	49.37	213,515	33.95	46.16
100	149	0.2092	18.84	30.53	188,927	30.04	16.12
150	105	0.0602	5.42	25.11	62,440	9.93	6.19
200	74	0.0298	2.69	22.42	15,427	2.45	3.74
325	44	0.0547	4.92	17.50	7,035	1.12	2.62
Pan	(- 44)	0.1944	17.50		16,480	2.62	
Total		1.1106	99.99		628,860	99.99	

Orig. Wt. 1.1901 g

CS I Sample B-030

Tyler Mesh	Sieve Opening (microns)	Mass Retained (grams)	Percent of Mass Retained	Cumulative Percent of Mass Less Than Stated Size	Gamma Activity (cpm)	Percent of Activity Retained	Cumulative Percent of Activity Less Than Stated Size
24	710	0.0303	2.45	99.16	1,077	0.46	99.58
42	350	0.1402	11.33	87.83	43,316	18.43	81.15
65	210	0.1757	14.20	73.63	94,065	40.03	41.12
100	149	0.0842	6.81	66.82	50,580	21.53	19.59
150	105	0.0520	4.20	62.62	14,836	6.31	13.28
200	74	0.1010	9.78	52.84	8,819	3.75	9.53
325	44	0.2060	16.65	36.19	10,421	4.43	5.10
Pan	(- 44)	0.4477	36.19		11,982	5.10	
Total		1.2371	101.61		235,096	100.04	

Orig. Wt. 1.2478 g

TABLE E.2 CONTINUED

CS I Sample C-030

Tyler Mesh	Sieve Opening (microns)	Mass Retained (grams)	Percent of Mass Retained	Cumulative Percent of Mass Less Than Stated Size	Gamma Activity (cpm)	Percent of Activity Retained	Cumulative Percent of Activity Less Than Stated Size
24	710	0.0458	1.35	98.64	335	0.12	99.87
42	350	0.0965	2.86	95.78	30,177	10.99	88.88
65	210	0.2356	6.97	88.81	114,799	41.80	47.08
100	149	0.1480	4.38	84.43	81,284	29.60	17.48
150	105	0.0993	2.94	81.49	11,202	4.08	13.40
200	74	0.2462	7.29	74.20	10,037	3.65	9.75
325	44	0.7143	21.14	53.06	9,449	3.44	6.31
Pan	(- 44)	1.7925	53.06		17,318	6.31	
Total		3.3782	99.99		274,601	99.99	

Orig. Wt. 3.3994 g

CS I Sample D-030

Tyler Mesh	Sieve Opening (microns)	Mass Retained (grams)	Percent of Mass Retained	Cumulative Percent of Mass Less Than Stated Size	Gamma Activity (cpm)	Percent of Activity Retained	Cumulative Percent of Activity Less Than Stated Size
24	710	0.0699	2.65	97.34	736	0.28	99.73
42	350	0.0777	2.95	94.39	20,301	7.69	92.04
65	210	0.2007	7.62	86.77	105,602	40.01	52.03
100	149	0.1350	5.12	81.65	66,514	25.20	26.83
150	105	0.0956	3.63	78.02	29,385	11.13	15.70
200	74	0.1862	7.07	70.95	10,690	4.05	11.65
325	44	0.4204	15.96	54.99	12,109	4.59	7.06
Pan	(- 44)	1.4484	54.99		18,622	7.06	
Total		2.6339	99.99		263.459	100.01	

Orig. Wt. 2.6894 g

TABLE E.2 CONTINUED

CS I Sample F-030

Tyler Mesh	Sieve Opening (microns)	Mass Retained (grams)	Percent of Mass Retained	Cumulative Percent of Mass Less Than Stated Size	Gamma Activity (cpm)	Percent of Activity Retained	Cumulative Percent of Activity Less Than Stated Size
24	710	0.1023	5.79	94.21	384	0.13	99.89
42	350	0.1201	6.80	87.41	2,707	0.94	98.95
65	210	0.2107	11.93	75.48	76,947	26.84	72.11
100	149	0.1855	10.50	64.98	112,294	39.17	32.94
150	105	0.1095	6.20	58.78	43,660	15.23	17.71
200	74	0.1723	9.76	49.02	21,345	7.45	10.26
325	44	0.2986	16.91	32.11	10,784	3.76	6.50
Pan	(- 44)	0.5670	32.11		18,625	6.50	
Total		1.7660	100.00		286,766	100.02	

Orig. Wt. 1.8269 g

CS I Sample H-030

Tyler Mesh	Sieve Opening (microns)	Mass Retained (grams)	Percent of Mass Retained	Cumulative Percent of Mass Less Than Stated Size	Gamma Activity (cpm)	Percent of Activity Retained	Cumulative Percent of Activity Less Than Stated Size
24	710	0.0068	0.32	99.67	767	0.30	99.73
42	350	0.1324	6.22	93.45	1,697	0.64	99.09
65	210	0.3869	18.17	75.28	17,206	6.50	92.59
100	149	0.3512	16.50	58.78	76,752	28.99	63.60
150	105	0.2100	9.86	48.92	82,938	31.33	32.27
200	74	0.1836	8.62	40.30	41,425	15.65	16.62
325	44	0.2821	13.25	27.05	17,894	6.76	9.86
Pan	(- 44)	0.5759	27.05		26,112	9.86	
Total		2.1289	99.9		264,791	100.0	

Orig. Wt. 2.2004 g

TABLE E.3 DISTRIBUTION OF MASS AND GAMMA ACTIVITY AMONG DRY-SIEVED PARTICLE-SIZE FRACTIONS OF CLEAN SLATE II FALLOUT SAMPLES

CS II Sample AJ-08(a)

Tyler Mesh	Sieve Opening (microns)	Mass Retained (grams)	Percent of Mass Retained	Cumulative Percent of Mass Less Than Stated Size	Gamma Activity (cpm)	Percent of Activity Retained	Cumulative Percent of Activity Less Than Stated Size
24	710	0.2713	2.69	97.31	Bkg	Bkg	100.00
42	350	0.9047	8.99	88.32	2,885	7.42	92.58
65	210	1.1429	11.35	76.97	1,626	4.18	88.40
100	149	1.5492	15.39	61.58	4,007	10.31	78.09
150	105	0.9902	9.84	51.74	3,296	8.48	69.61
200	74	2.2081	21.93	29.81	6,039	15.54	54.07
325	44	1.6749	16.64	13.17	8,268	21.27	32.80
Pan	(- 44)	1.3255	13.17		12,752	32.80	
Total		10.0668	100.00		38,873	100.00	

Orig. Wt. 10.1051 g aliquot of total sample

CS II Sample BK-10(a)

Tyler Mesh	Sieve Opening (microns)	Mass Retained (grams)	Percent of Mass Retained	Cumulative Percent of Mass Less Than Stated Size	Gamma Activity (cpm)	Percent of Activity Retained	Cumulative Percent of Activity Less Than Stated Size
24	710	0.1418	2.13	97.69	Bkg	Bkg	98.99
42	350	0.1832	2.76	94.93	Bkg	Bkg	98.99
65	210	0.4260	6.42	88.51	608	2.12	96.87
100	149	0.2267	3.41	85.10	466	1.63	95.24
150	105	1.9090	28.75	56.35	5,222	18.23	77.01
200	74	1.3887	20.75	35.60	4,747	15.57	61.44
325	44	1.3485	20.31	15.29	7,682	26.82	34.62
Pan	(- 44)	1.0150	15.29		9,914	34.62	
Total		6.6389	99.82		28.639	98.9	

Orig. Wt. 6.6699 g aliquot of total sample.

TABLE E.3 CONTINUED

CS II Sample BL-10(a)

Tyler Mesh	Sieve Opening (microns)	Mass Retained (grams)	Percent of Mass Retained	Cumulative Percent of Mass Less Than Stated Size	Gamma Activity (cpm)	Percent of Activity Retained	Cumulative Percent of Activity Less Than Stated Size
24	710	0.0050	0.06	99.87	Bkg	Bkg	100.07
42	350	0.0394	0.48	99.39	112	0.31	99.76
65	210	0.3702	4.53	94.86	573	1.58	98.18
100	149	0.2216	2.71	92.15	152	0.42	97.76
150	105	1.9561	23.96	68.19	4,232	11.66	86.10
200	74	1.7286	21.18	47.01	4,551	12.54	73.56
325	44	1.4542	22.72	24.29	8,461	23.31	50.25
Pan	(- 44)	1.9824	24.29		18,242	50.25	
Total		8.1625	99.93		36,323	100.07	

Orig. Wt. 8.2090 g aliquot of total sample.

CS II Sample BM-05(a)

Tyler Mesh	Sieve Opening (microns)	Mass Retained (grams)	Percent of Mass Retained	Cumulative Percent of Mass Less Than Stated Size	Gamma Activity (cpm)	Percent of Activity Retained	Cumulative Percent of Activity Less Than Stated Size
24	710	0.0121	0.03	99.97	219	0.05	99.96
42	350	0.0290	0.07	99.90	239	0.05	99.91
65	210	0.0783	0.18	99.72	282	0.06	99.85
100	149	0.1003	0.23	99.49	100	0.02	99.83
150	105	0.5105	1.19	98.30	574	0.13	99.70
200	74	0.9691	2.26	96.04	1,288	0.29	99.41
325	44	2.3406	5.61	89.43	14,533	3.28	96.13
Pan	(- 44)	38.4000	89.43		425,857	96.13	
Total		42.9399	100.00		443,092	100.01	

Orig. Wt. 43.005 g aliquot of total sample.

TABLE E.3 CONTINUED

CS II Sample BC-04(a)

Tyler Mesh	Sieve Opening (microns)	Mass Retained (grams)	Percent of Mass Retained	Cumulative Percent of Mass Less Than Stated Size	Gamma Activity (cpm)	Percent of Activity Retained	Cumulative Percent of Activity Less Than Stated Size
24	710	0.0243	0.26	99.75	129	0.16	99.87
42	350	1.5600	16.93	82.82	9,333	11.87	88.00
65	210	3.1455	34.14	48.68	22,628	28.79	59.31
100	149	0.8631	9.37	39.31	6,112	7.78	51.43
150	105	2.0560	22.32	16.99	18,057	22.97	28.46
200	74	0.6403	6.95	10.04	6,956	8.85	19.61
325	44	0.4763	5.17	4.87	7,435	9.46	10.15
Pan	(- 44)	0.4483	4.87		7,980	10.15	
Total		9.2128	100.01		78,630	100.03	

Orig. Wt. 9.1934 g aliquot of original sample.

CS II Sample A-030(a)

Tyler Mesh	Sieve Opening (microns)	Mass Retained (grams)	Percent of Mass Retained	Cumulative Percent of Mass Less Than Stated Size	Gamma Activity (cpm)	Percent of Activity Retained	Cumulative Percent of Activity Less Than Stated Size
24	710	0.0090	0.10	99.86	127	0.17	99.86
42	350	0.0292	0.34	99.52	90	0.12	99.74
65	210	0.8836	10.37	89.15	6,675	9.09	90.65
100	149	1.8522	21.74	67.41	13,858	18.88	71.77
150	105	2.5024	29.37	38.04	17,629	24.02	47.75
200	74	1.8285	21.44	16.60	13,364	18.21	29.54
325	44	1.1986	14.07	2.53	15,396	20.84	8.70
Pan	(- 44)	0.2160	2.53		6,377	8.70	
Total		8.5195	99.96		73,426	100.03	

Orig. Wt. 8.5223 g aliquot of original sample.

TABLE E.3 CONTINUED

CS II Sample B-030

Tyler Mesh	Sieve Opening (microns)	Mass Retained (grams)	Percent of Mass Retained	Cumulative Percent of Mass Less Than Stated Size	Gamma Activity (cpm)	Percent of Activity Retained	Cumulative Percent of Activity Less Than Stated Size
24	710	0.0249	0.04	99.96	Bkg	Bkg	100.01
42	350	0.0405	0.07	99.89	295	0.04	99.97
65	210	0.0548	0.09	99.80	337	0.04	99.93
100	149	0.3152	0.54	99.26	1,557	0.20	99.73
150	105	1.7101	2.91	96.35	13,381	1.69	98.04
200	74	13.2000	22.45	73.90	90,548	11.44	86.60
325	44	27.1990	46.26	27.64	319,995	40.42	46.18
Pan	(- 44)	16,2500	27.64		365,587	46.18	
Total		58.7945	100.00		791,700	100.01	

Orig. Wt. 59.450 g

CS II Sample C-030

Tyler Mesh	Sieve Opening (microns)	Mass Retained (grams)	Percent of Mass Retained	Cumulative Percent of Mass Less Than Stated Size	Gamma Activity (cpm)	Percent of Activity Retained	Cumulative Percent of Activity Less Than Stated Size
24	710	0.0128	0.08	99.90	484	0.22	99.81
42	350	0.0234	0.15	99.75	197	0.09	99.72
65	210	0.0208	0.14	99.61	60	0.03	99.69
100	149	0.0480	0.32	99.29	111	0.05	99.64
150	105	0.1259	0.84	98.45	460	0.21	99.43
200	74	1.5358	10.22	88.23	5,674	2.58	96.85
325	44	6.8292	45.46	42.77	84,675	38.45	58.40
Pan	(- 44)	6.4255	42.77		128,607	58.40	
Total		15.0214	99.98		220,268	100.03	

Orig. Wt. 15.1360 g

TABLE E.3 CONTINUED

CS II Sample D-030

Tyler Mesh	Sieve Opening (microns)	Mass Retained (grams)	Percent of Mass Retained	Cumulative Percent of Mass Less Than Stated Size	Gamma Activity (cpm)	Percent of Activity Retained	Cumulative Percent of Activity Less Than Stated Size
24	710	0.0108	0.13	99.86	197	0.12	99.87
42	350	0.0176	0.21	99.65	Bkg	Bkg	99.87
65	210	0.0375	0.44	99.21	549	0.33	99.54
100	149	0.0314	0.37	99.84	769	0.46	99.08
150	105	0.1032	1.21	97.63	1,043	0.62	98.47
200	74	0.4168	4.90	92.73	1,113	0.66	97.80
325	44	3.6214	42.62	50.11	45,217	27.05	70.75
Pan	(- 44)	4.2574	50.11		118,252	70.75	
Total		8.4961	99.69		167,140	99.99	

Orig. Wt. 8.520 g

CS II Sample F-030

Tyler Mesh	Sieve Opening (microns)	Mass Retained (grams)	Percent of Mass Retained	Cumulative Percent of Mass Less Than Stated Size	Gamma Activity (cpm)	Percent of Activity Retained	Cumulative Percent of Activity Less Than Stated Size
24	710	0.0	Bkg	99.99	- -	-	100.03
42	350	0.0342	0.36	99.63	302	0.25	99.78
65	210	0.0941	1.00	98.63	651	0.53	99.25
100	149	0.1158	1.23	97.40	5,003	4.08	95.17
150	105	0.4453	4.74	92.66	18,251	14.89	80.28
200	74	0.2521	2.68	89.98	5,739	4.68	75.60
325	44	2.3686	25.20	64.78	20,800	16.96	58.64
Pan	(- 44)	6.0885	64.78		71,893	58.64	
Total		9.3986	99.99		122,639	100.03	

Orig. Wt. 9.3694 g

TABLE E.3 CONTINUED

CS II Sample H-030

Tyler Mesh	Sieve Opening (microns)	Mass Retained (grams)	Percent of Mass Retained	Cumulative Percent of Mass Less than Stated Size	Gamma Activity (cpm)	Percent of Activity Retained	Cumulative Percent of Activity Less Than Stated Size
24	710	0.0699	2.43	97.56	260	0.84	99.17
42	350	0.0760	2.64	94.92	276	0.89	98.28
65	210	0.1556	5.41	89.51	351	1.13	97.15
100	149	0.0553	1.92	87.59	Bkg	Bkg	97.15
150	105	0.2592	9.01	78.58	980	3.15	94.00
200	74	0.2452	8.53	70.05	1,239	3.98	90.02
325	44	0.5059	17.59	52.46	3,935	12.63	77.39
Pan	(- 44)	1.5088	52.46		24,101	77.39	
Total		2.8759	99.99		31,142	100.01	

Orig. Wt. 2.8908 g

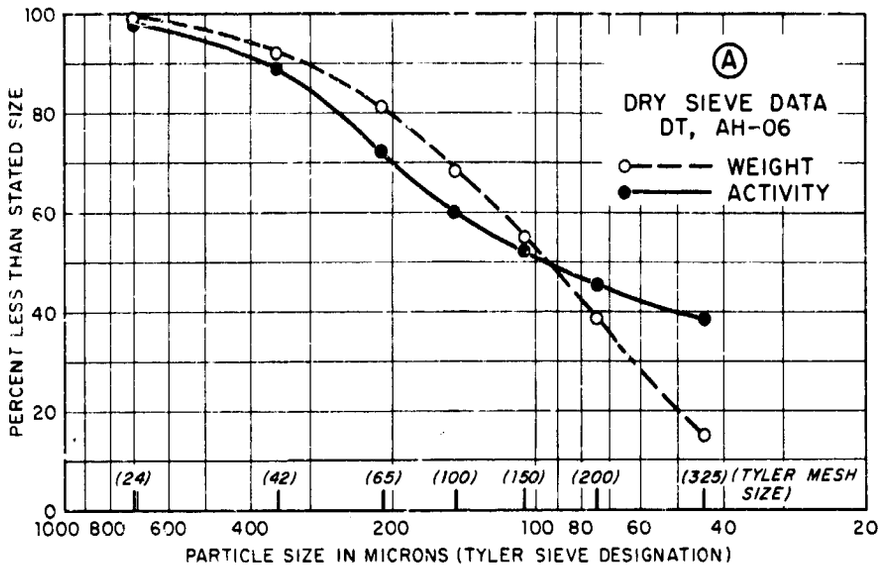


Figure E.1 (A) Sample AH-06.

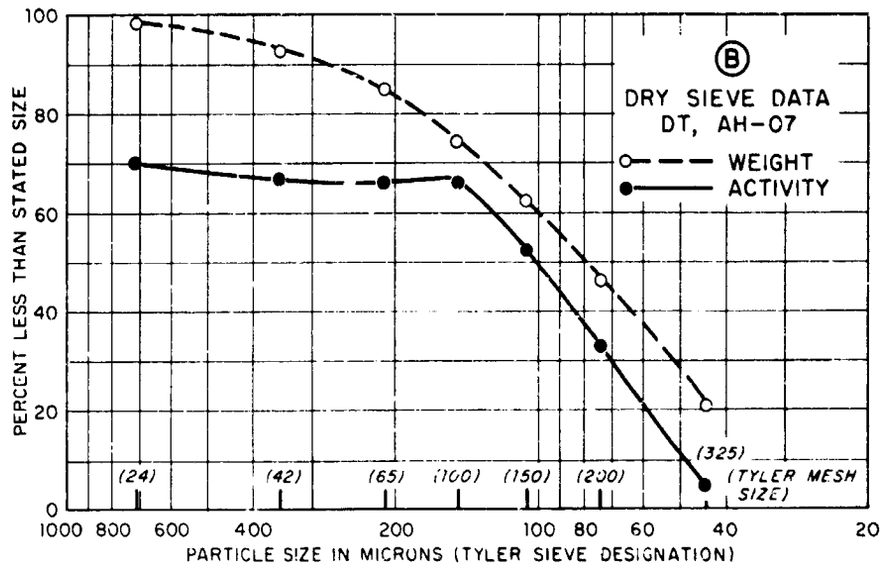


Figure E.1 (B) Sample AH-07.

Figure E.1 Distribution of mass and gamma activity among dry-sieved particle-size fractions of Double Tracks fallout samples.

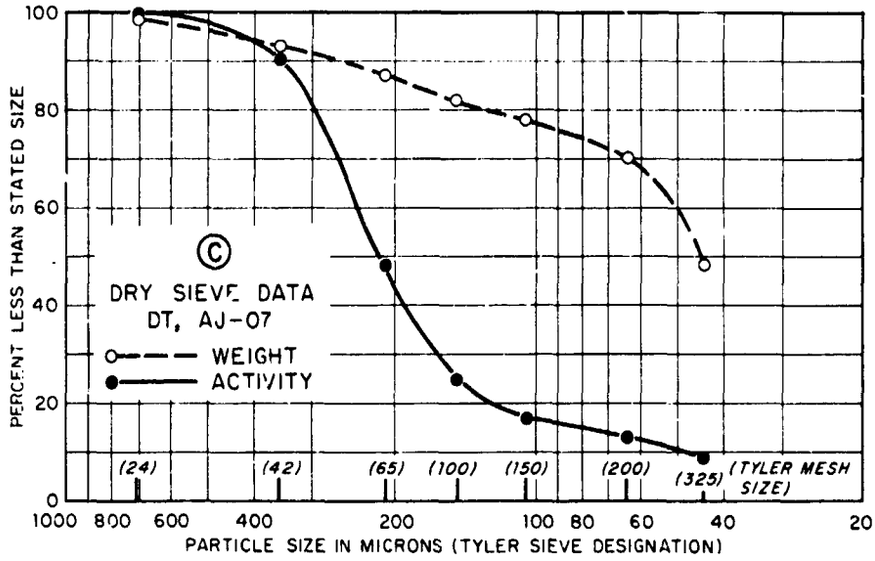


Figure E.1 (C) Sample AJ-07.

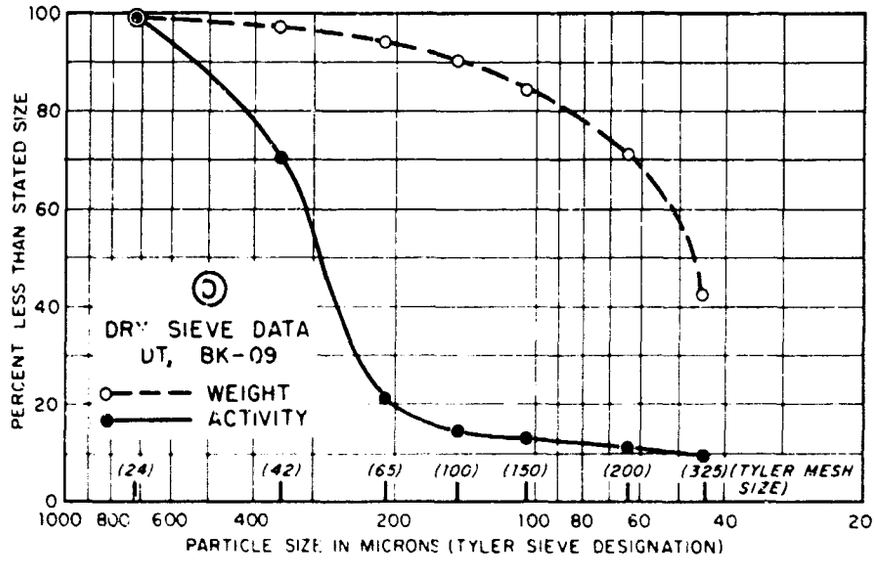


Figure E.1 (D) Sample BK-09.

Figure E.1 Continued.

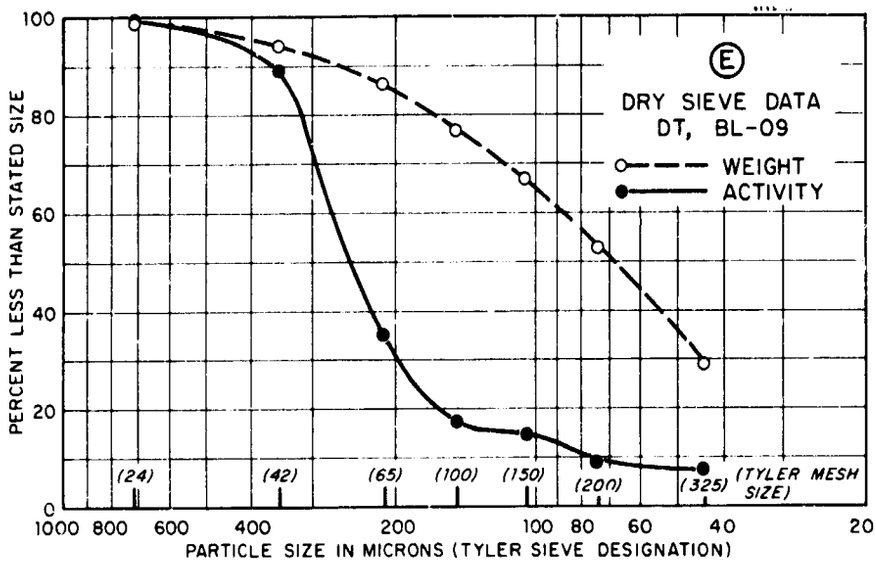


Figure E.1 (E) Sample BL-09.

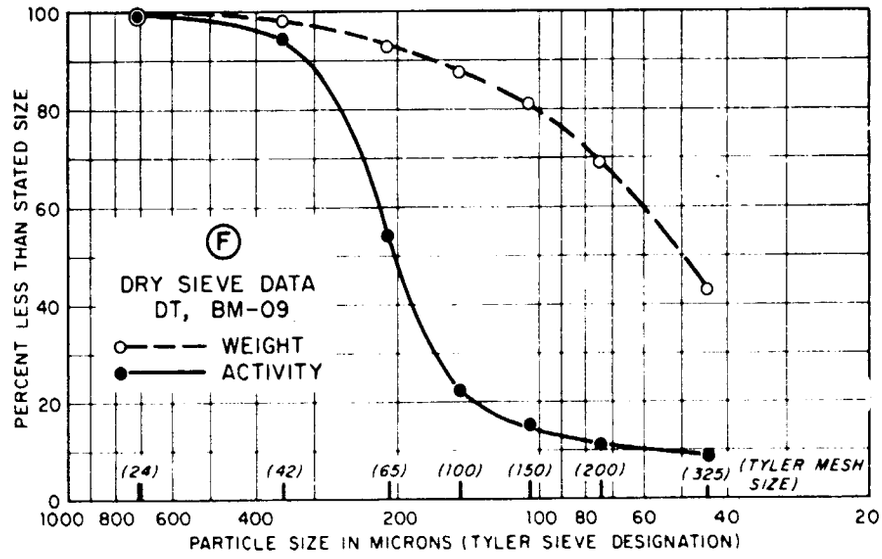


Figure E.1 (F) Sample BM-09.

Figure E.1 Continued.

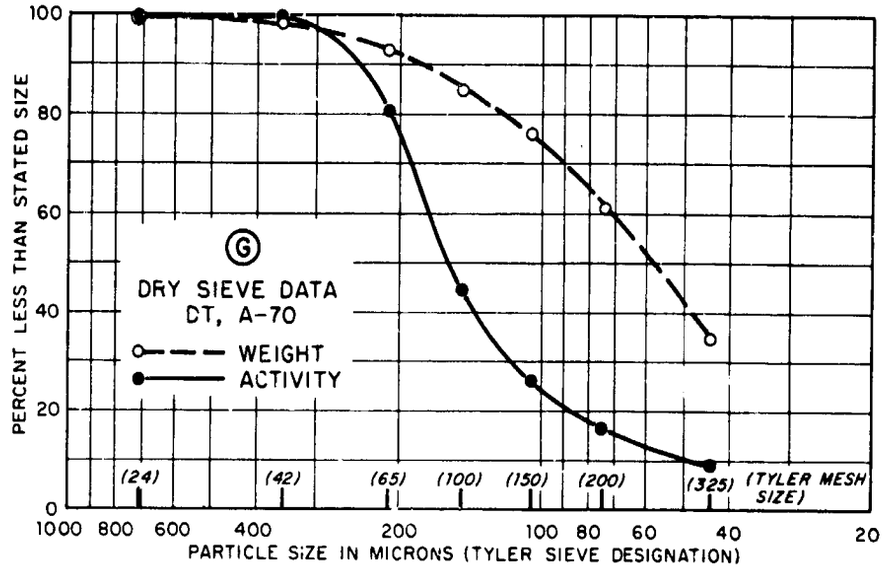


Figure E.1 (G) Sample A-70.

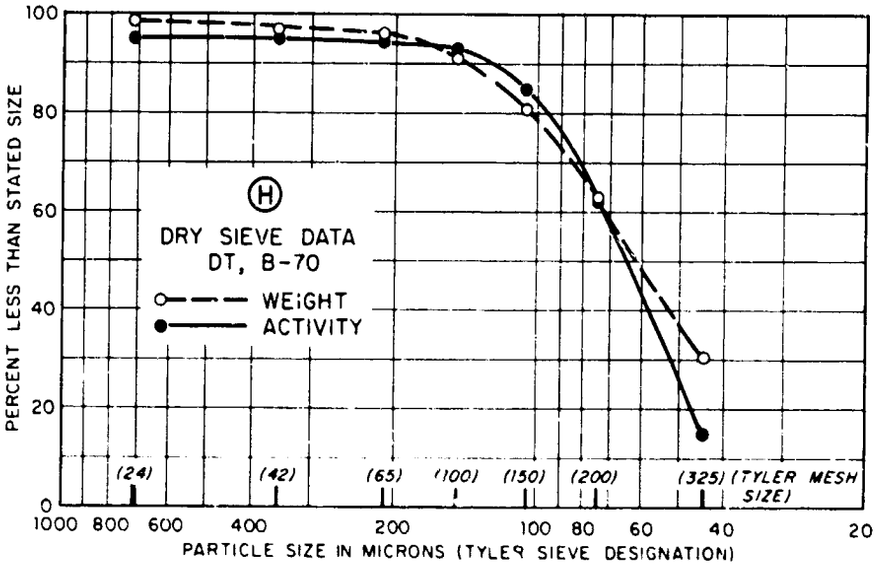


Figure E.1 (H) Sample B-70.

Figure E.1 Continued.

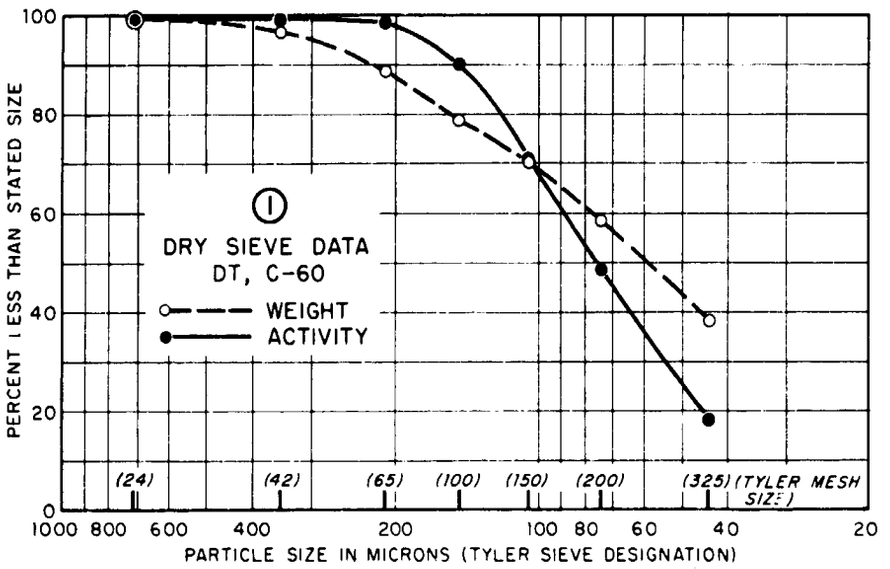


Figure E.1 (I) Sample C-60.

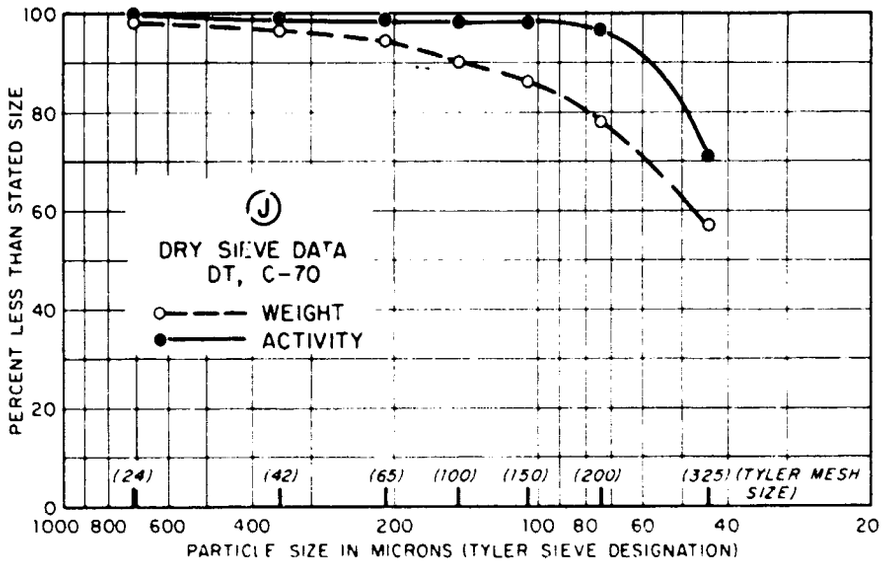


Figure E.1 (J) Sample C-70.

Figure E.1 Continued.

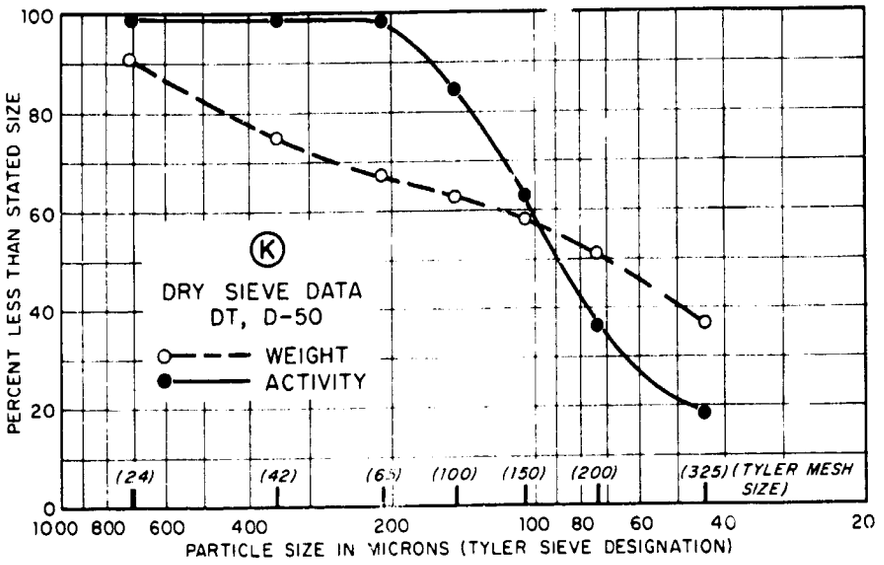


Figure E.1 (K) Sample D-50.

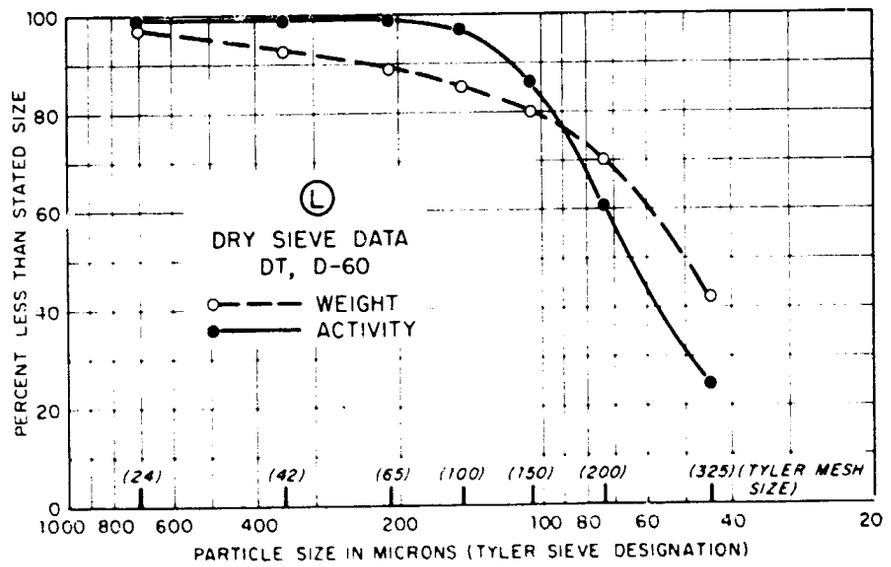


Figure E.1 (L) Sample D-60.

Figure E.1 Continued.

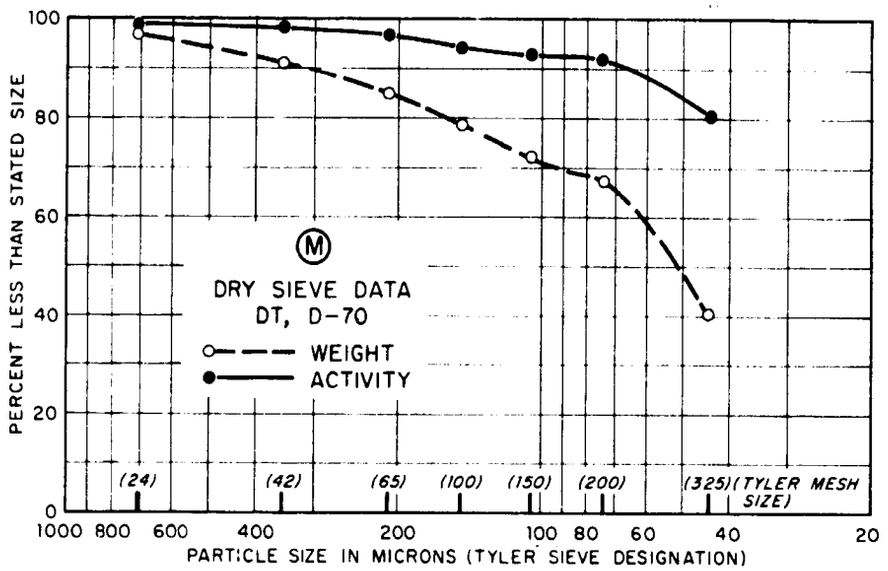


Figure E.1 (M) Sample D-70.

Figure E.1 Continued.

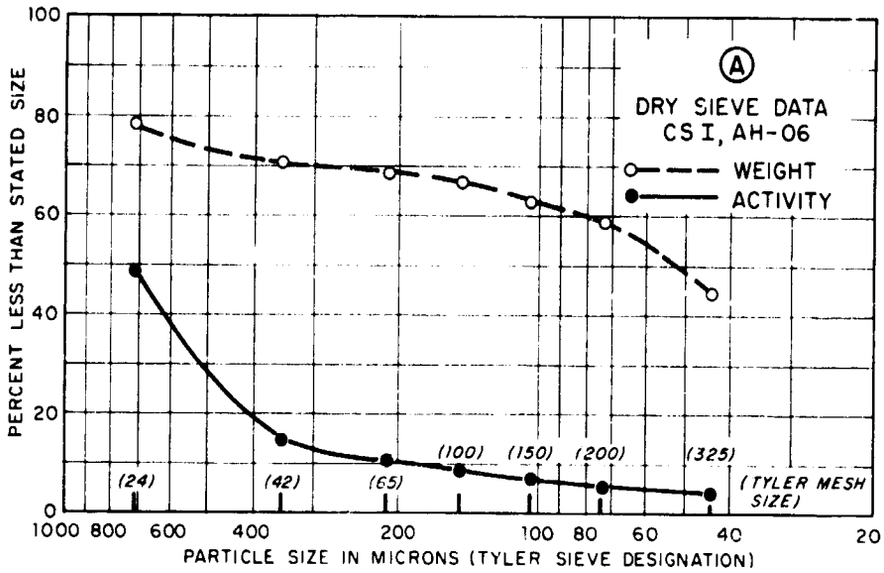


Figure E.2 (A) Sample AH-06.

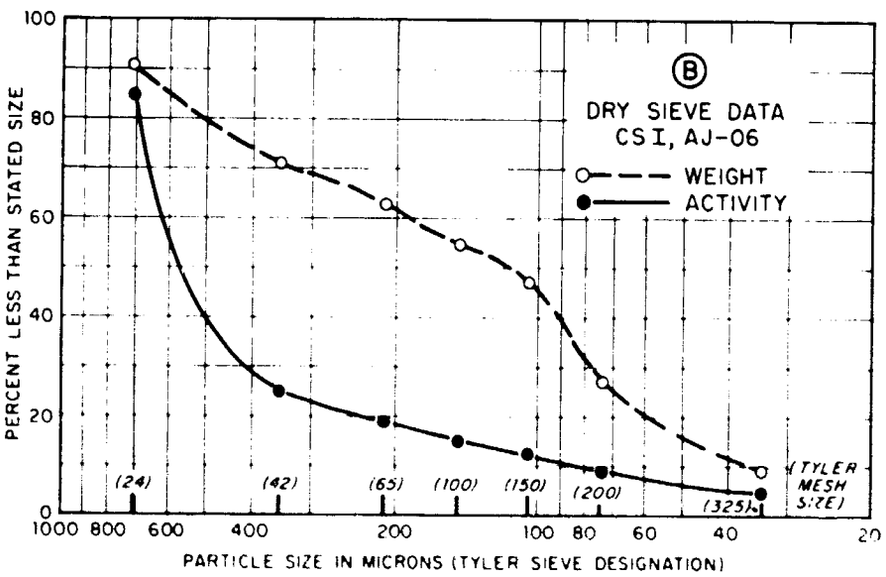


Figure E.2 (B) Sample AJ-06.

Figure E.2 Distribution of mass and gamma activity among dry-sieved particle-size fractions of Clean Slate I fallout samples.

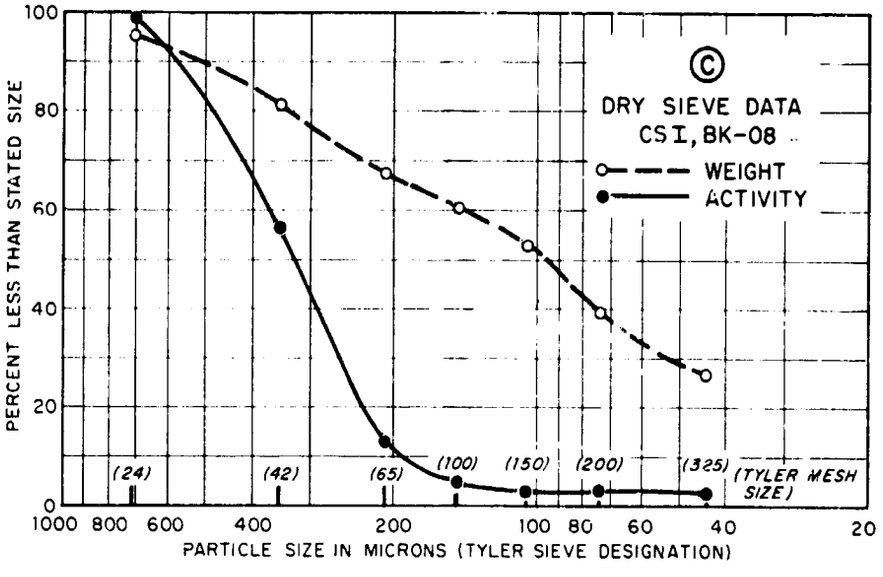


Figure E.2 (C) Sample BK-08.

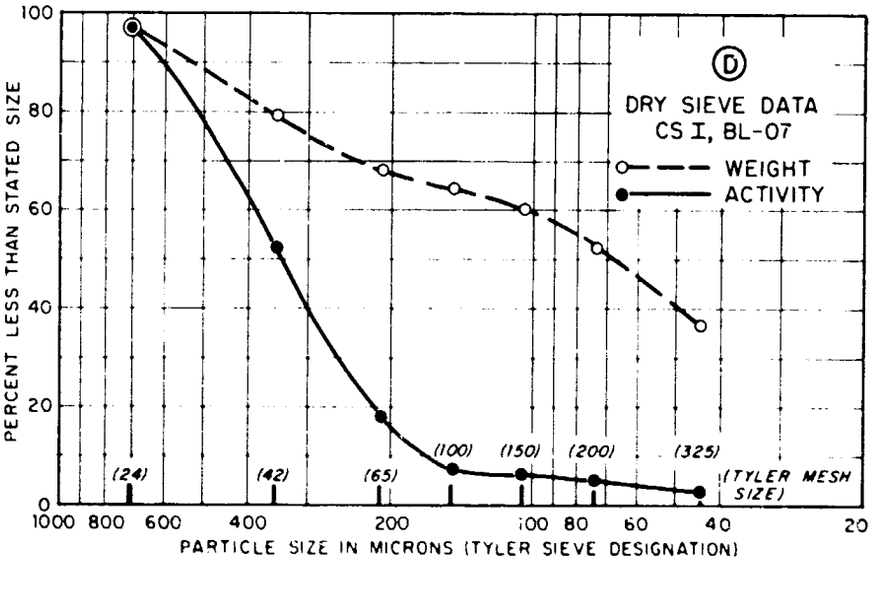


Figure E.2 (D) Sample BL-07.

Figure E.2 Continued.

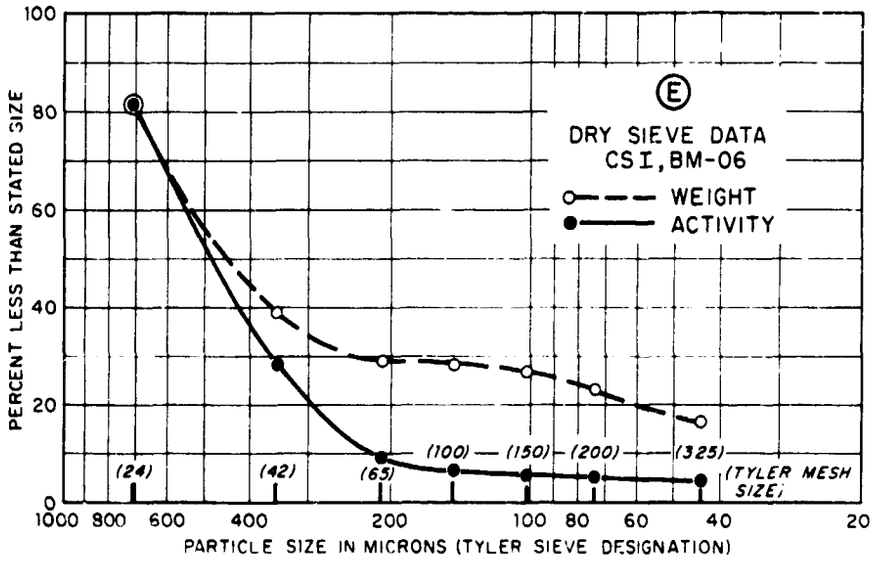


Figure E.2 (E) Sample BM-06.

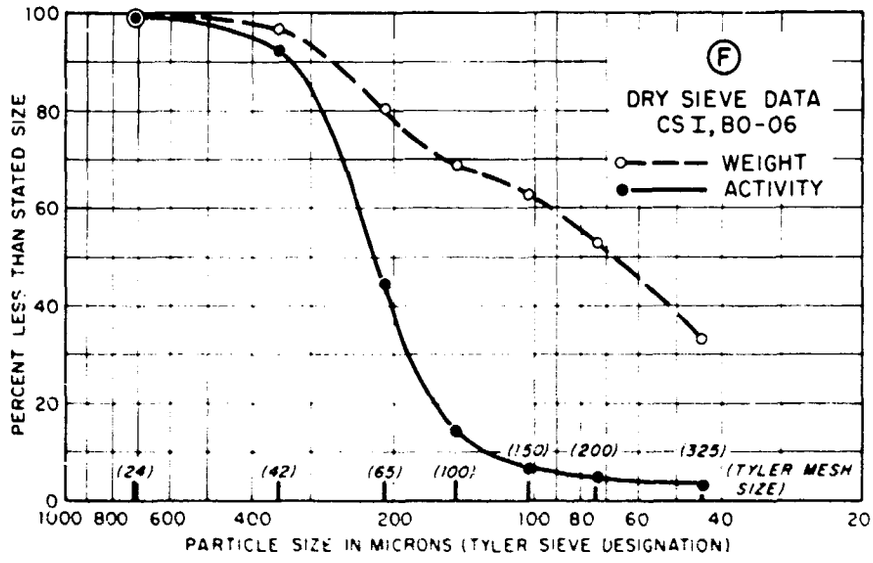


Figure E.2 (F) Sample BO-06.

Figure E.2 Continued.

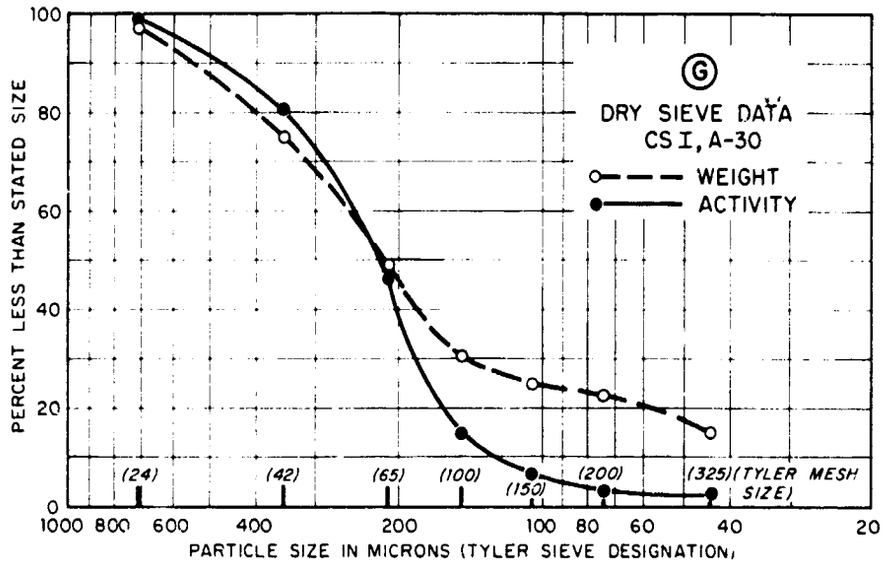


Figure E.2 (G) Sample A-30.

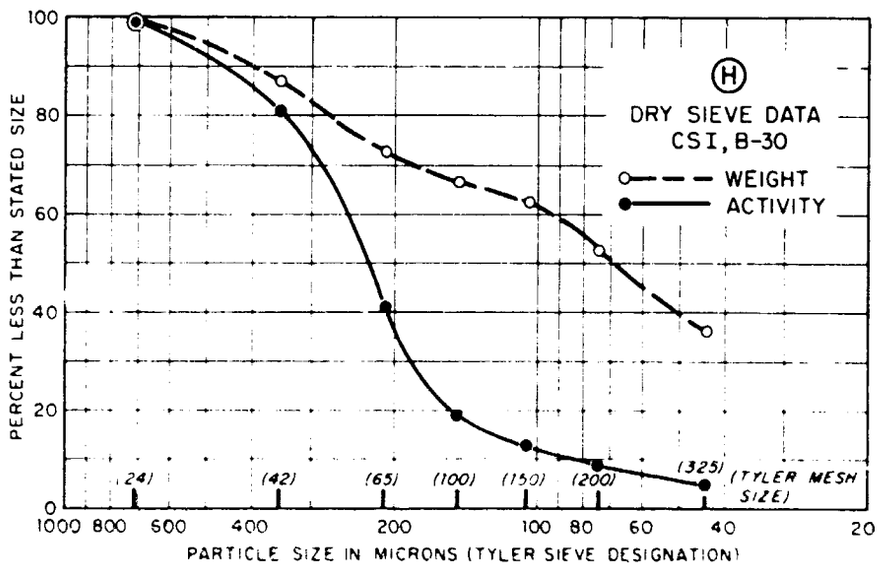


Figure E.2 (H) Sample B-30.

Figure E.2 Continued.

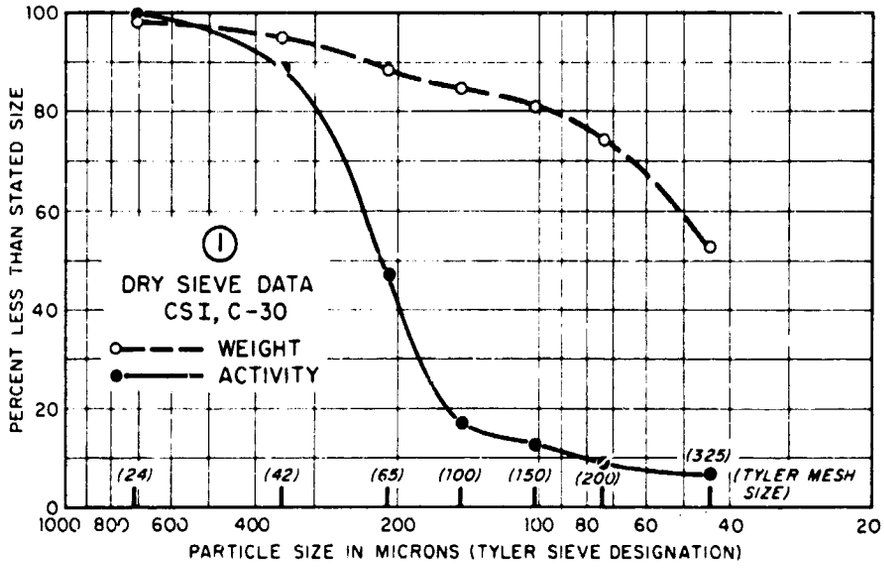


Figure E.2 (I) Sample C-30.

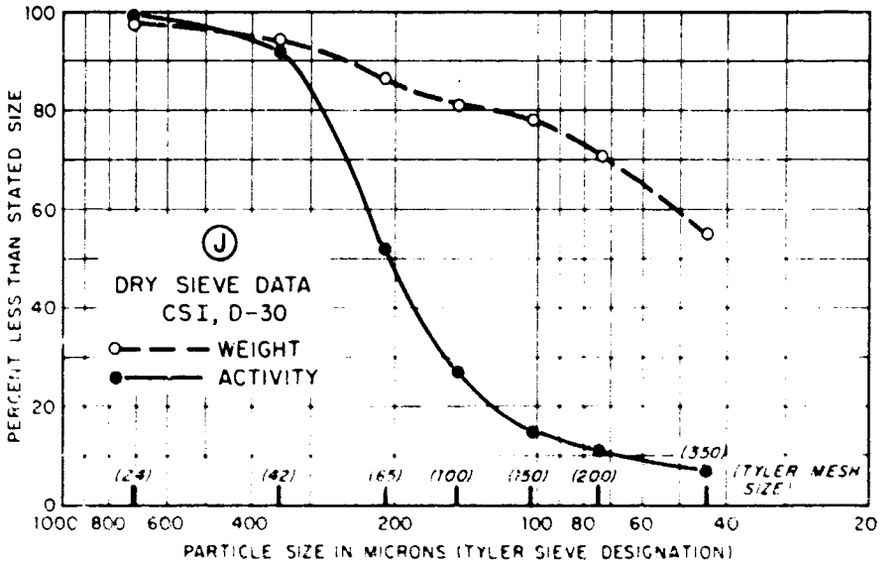


Figure E.2 (J) Sample D-30.

Figure E.2 Continued.

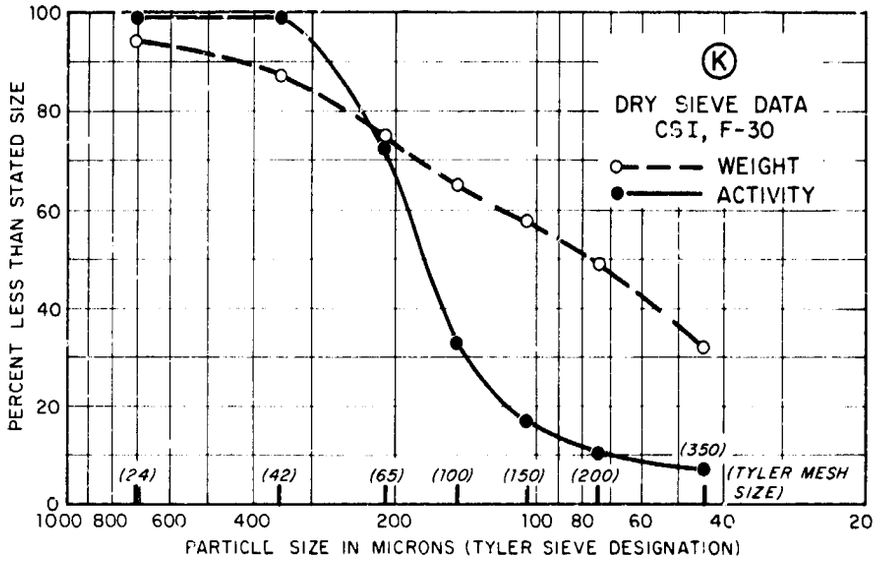


Figure E.2 (K) Sample F-30.

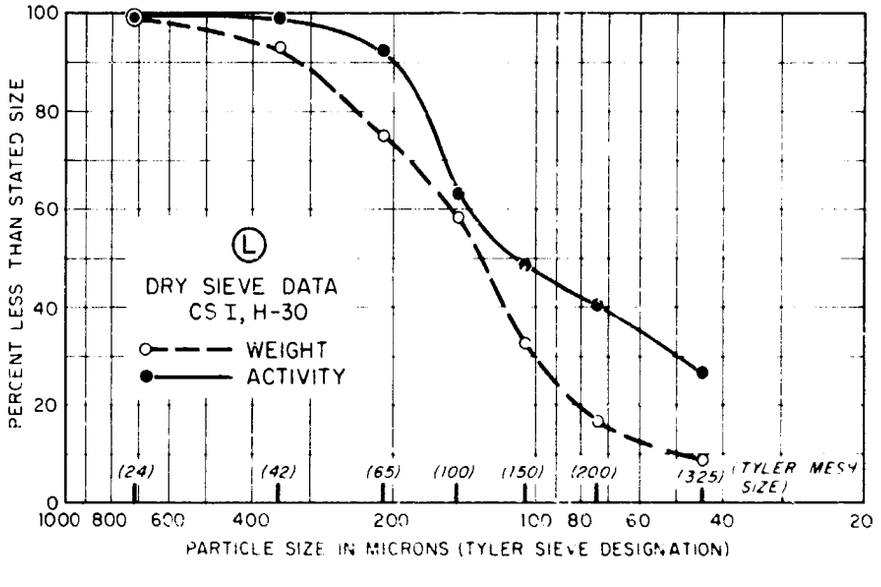


Figure E.2 (L) Sample H-30.

Figure E.2 Continued.

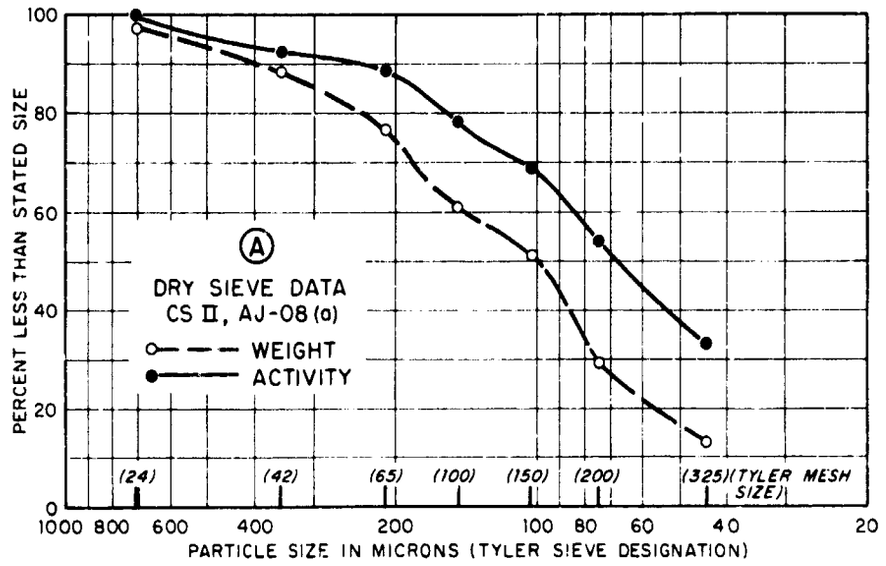


Figure E.3 (A) Sample AJ-08(a).

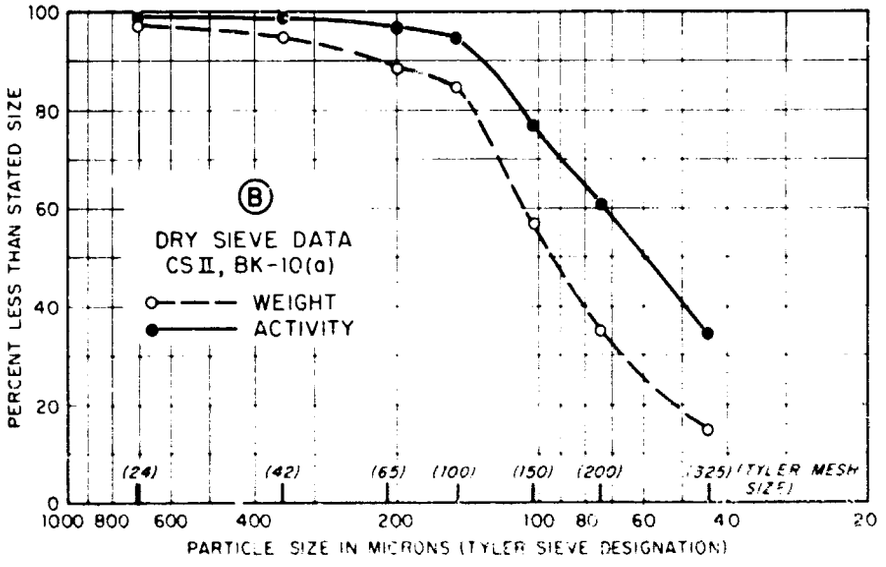


Figure E.3 (B) Sample BK-10(a).

Figure E.3 Distribution of mass and gamma activity among dry-sieved particle-size fractions of Clean Slate II fallout samples.

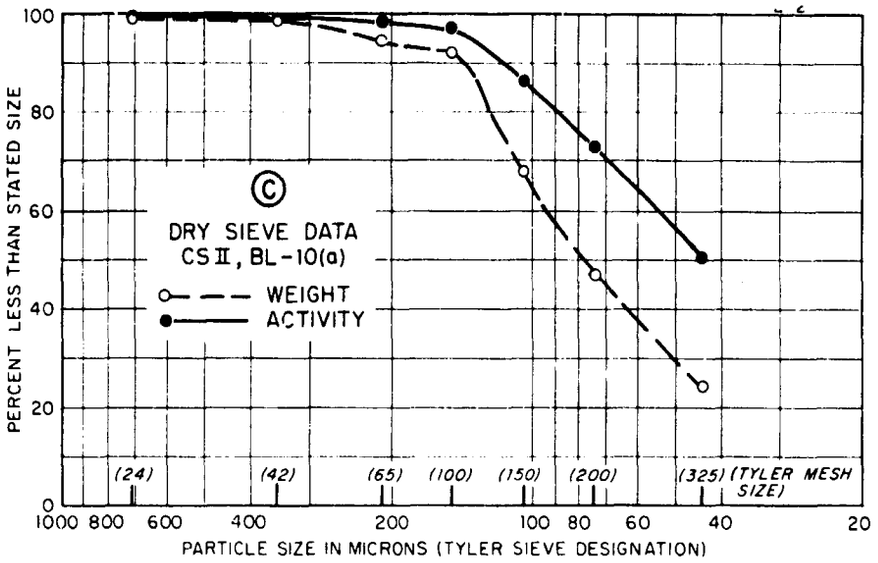


Figure E.3 (C) Sample BL-10(a).

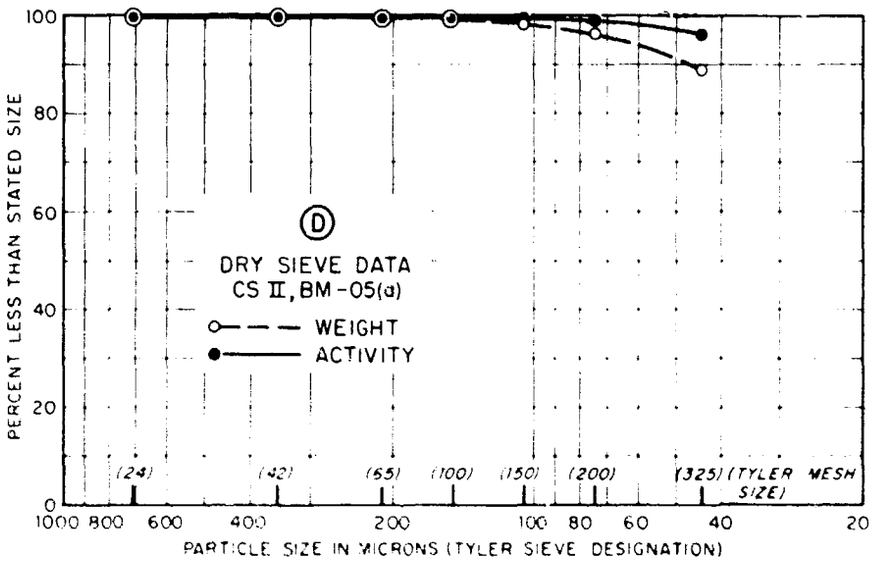


Figure E.3 (D) Sample BM-05(a).

Figure E.3 Continued.

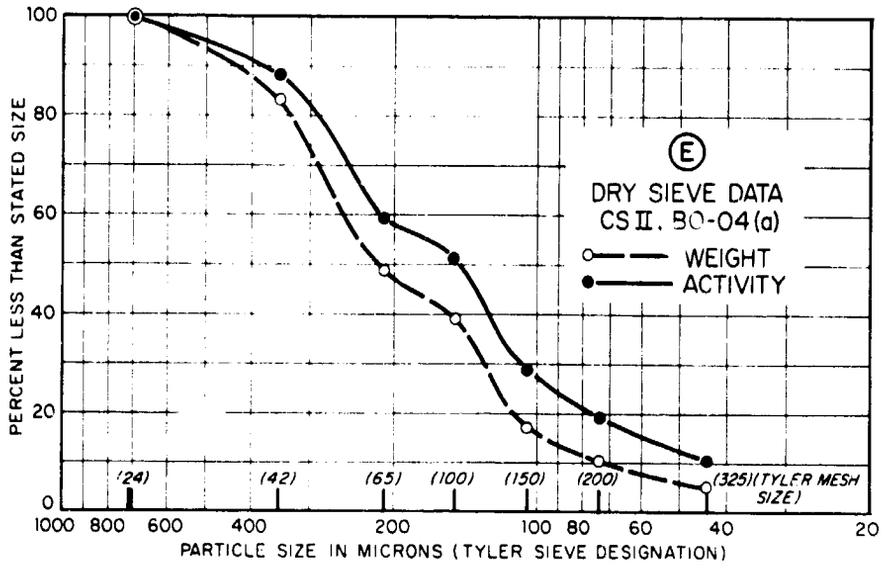


Figure E.3 (E) Sample BO-04(a).

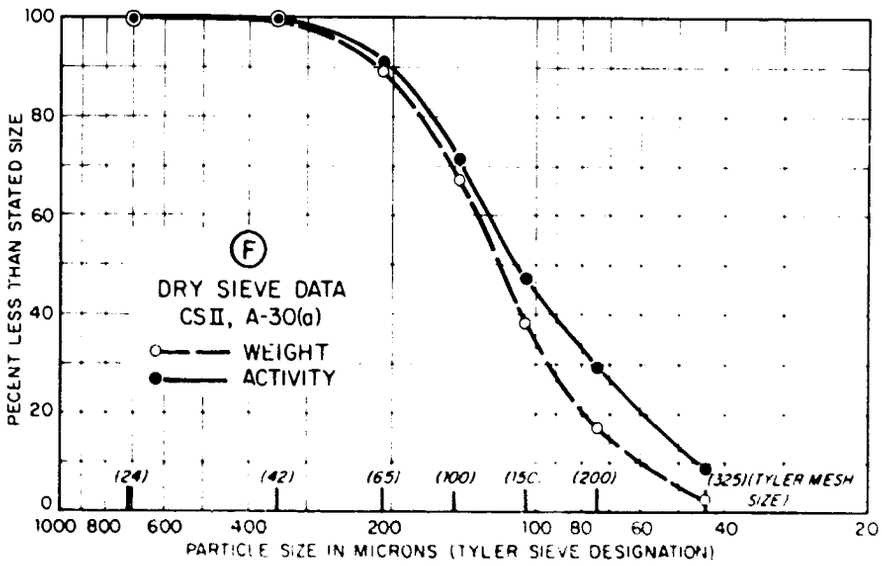


Figure E.3 (F) Sample A-30(a).

Figure E.3 Continued.

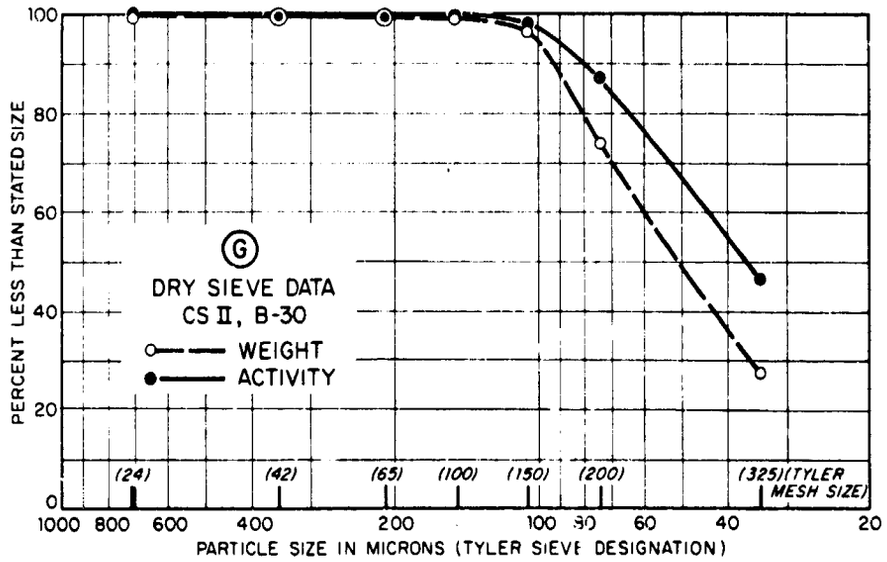


Figure E.3 (G) Sample B-30.

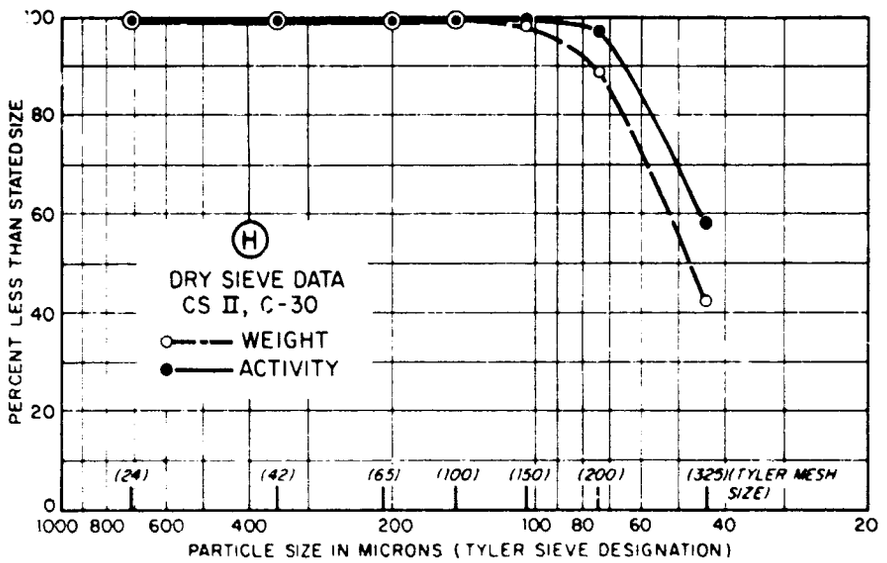


Figure E.3 (H) Sample C-30.

Figure E.3 Continued.

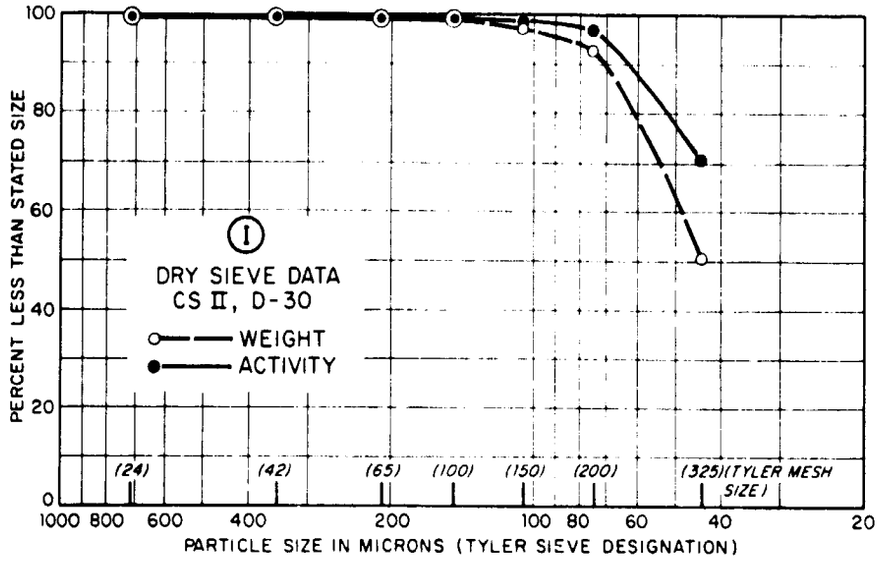


Figure E.3 (I) Sample D-30.

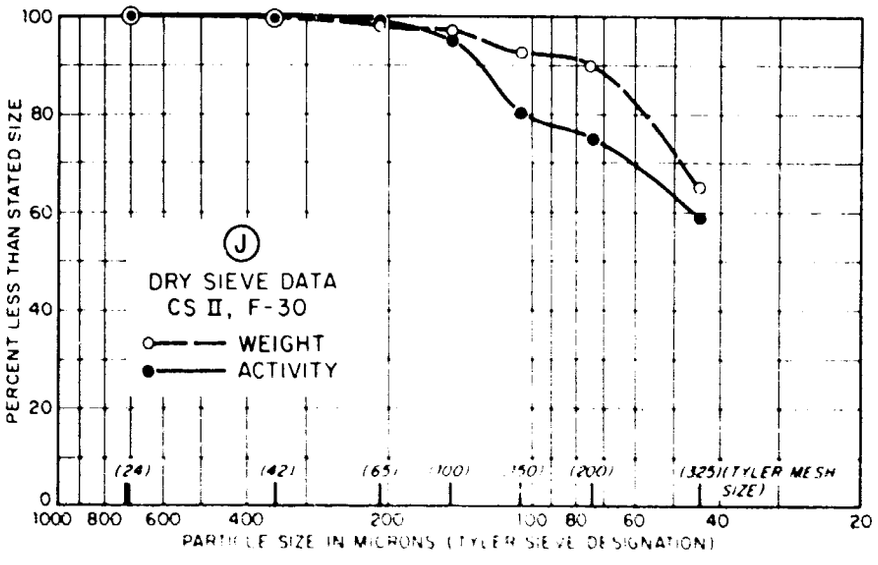


Figure E.3 (J) Sample F-30.

Figure E.3 Continued.

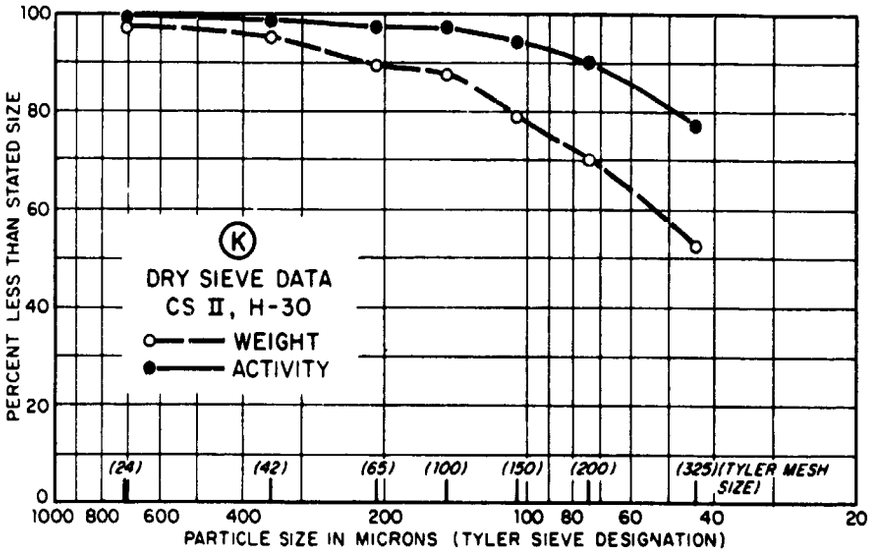


Figure E.3 (K) Sample H-30.

Figure E.3 Continued.

APPENDIX F

DISTRIBUTION OF MASS AND GAMMA ACTIVITY AMONG WET-SIEVED PARTICLE-SIZE FRACTIONS OF FALLOUT SAMPLES

Fallout samples were wet-sieved and each sieved fraction was weighed and gamma counted at NRDL. The percent of the weight and gamma activity retained by each sieve fraction and the cumulative percent less than the stated sieve size are tabulated (Tables F.1 through F.3) and displayed graphically (Figures F. 1 through F.3).

TABLE F.1 DISTRIBUTION OF MASS AND GAMMA ACTIVITY AMONG WET-SIEVED PARTICLE-SIZE FRACTIONS OF DOUBLE TRACKS FALLOUT SAMPLES

DT Sample AJ-07

Tyler Mesh	Sieve Opening (Microns)	Weight Retained (Grams)	Percent Of Mass Retained	Cumulative Percent Of Mass Less Than Stated Size	Gamma And X-ray Activity	Percent Activity Retained	Cumulative Percent Of Activity Less Than Stated Size
24	710	0.0458	1.27	98.74	1,250	0.06	99.92
42	350	0.4090	11.37	87.37	194,800	9.14	90.78
65	210	0.1712	4.76	82.61	606,900	28.50	62.28
100	149	0.0461	1.28	81.33	237,800	11.17	51.11
150	105	0.1392	3.89	77.44	355,100	16.67	34.44
200	74	0.3586	9.96	67.48	244,200	11.46	22.98
325	44	0.8025	22.31	45.17	167,100	7.85	15.13
Pan	(-44)	1.6250	45.17		319,250	14.99	0.14
Water	(-0.1)[a]				3,050	0.14	
TOTAL		3.5974[b]	100.01		2,129,450	99.98	

(a) 0.1 μ was calculated to be the maximum particle diameter not precipitated by centrifugation.
Original weight at TTR before sieving was 4.50.
(b) 1.0000 g aliquot given to Project 5.1a.

TABLE F.1 CONTINUED

DT Sample BM-09

Tyler Mesh	Sieve Opening (Microns)	Weight Retained (Grams)	Percent Of Mass Retained	Cumulative Percent Of Mass Less Than Stated Size	Gamma And X-ray Activity	Percent Activity Retained	Cumulative Percent Of Activity Less Than Stated Size
24	710	0.0042	0.15	99.81	117	0.01	99.95
42	350	0.0461	1.61	98.20	53,600	3.93	96.02
65	210	0.0510	1.78	96.42	434,600	31.86	64.16
100	149	0.0471	1.64	94.78	180,600	13.24	50.92
150	105	0.1237	4.31	90.47	205,900	15.09	35.83
200	74	0.4617	16.11	74.36	190,700	13.98	21.85
325	44	0.8871	30.96	43.40	102,300	7.50	14.35
	40	0.2108	7.36	36.04	16,940	1.24	13.11
	30	0.2699	9.42	26.62	30,210	2.21	10.90
	20	0.3195	11.15	15.47	38,955	2.85	8.05
	10	0.2229	7.78	7.69	40,010	2.93	5.12
	(-10)	0.2204	7.69		68,120	4.99	0.13
Water	(-0.1)[a]	———	———		1,750	0.13	
TOTAL		2.8644	99.96		1,363,802	99.96	

(a) 0.1 μ was calculated to be the maximum particle diameter not precipitated by centrifugation.
Original weight at TTR
before sieving was 3.32g.

TABLE F.1 CONTINUED

DT Sample A-070

Tyler Mesh	Sieve Opening (Microns)	Weight Retained (Grams)	Percent Of Mass Retained	Cumulative Percent Of Mass Less Than Stated Size	Gamma And X-ray Activity	Percent Activity Retained	Cumulative Percent Of Activity Less Than Stated Size
24	710	0.0012	0.11	99.89	150	0.01	99.97
42	350	0.0119	1.01	98.88	3,440	0.34	99.63
65	210	0.0551	4.67	94.21	168,300	16.81	82.82
100	149	0.0898	7.61	86.60	287,900	28.76	54.06
150	105	0.0941	7.97	78.63	171,900	17.17	36.89
200	74	0.1587	13.45	65.18	123,000	12.29	24.60
325	44	0.3046	25.80	39.38	94,700	9.46	15.14
Pan	(-44)	0.4648	39.38		150,500	15.04	0.10
Water	(-0.1)[a]	———	———		1,025	0.10	
TOTAL		1.1802 [b]	100.00		1,000,915	99.98	

(a) 0.1 μ was calculated to be the maximum particle diameter not precipitated by centrifugation.
Original weight at TTR
before sieving was 1.30 .

(b) 0.1000 g aliquot given to Project 5.1a.

TABLE F.1 CONTINUED

DT Sample D-050

Tyler Mesh	Sieve Opening (Microns)	Weight Retained (Grams)	Percent Of Mass Retained	Cumulative Percent Of Mass Less Than Stated Size	Gamma And X-ray Activity	Percent Activity Retained	Cumulative Percent Of Activity Less Than Stated Size
24	710	0.1143	9.53	90.45	177	0.06	99.92
42	350	0.2240	18.67	71.78	231	0.08	99.84
65	210	0.0930	7.75	64.03	4,696	1.62	98.22
100	149	0.0573	4.78	59.25	33,340	11.53	86.69
150	105	0.0526	4.38	54.87	62,540	21.63	65.06
200	74	0.0818	6.82	48.05	85,060	29.41	35.65
325	44	[illegible]	15.15	32.90	74,790	25.86	9.79
	40	06[illegible]	5.25	27.65	1,820	0.63	9.16
	30	0.0726	6.05	21.60	3,460	1.19	7.97
	20	0.0838	6.98	14.62	4,660	1.61	6.36
	10	0.0703	5.86	8.76	3,470	1.19	5.17
	(-10)	0.1051	8.76		14,500	5.01	0.16
Water	(-0.1)[a]				450	0.16	
TOTAL		1.1996[b]	99.98		289,194	99.98	

(a) 0.1 μ was calculated to be the maximum particle diameter that was not precipitated by centrifugation.
Original weight at TTR
before sieving was 1.52 .

(b) 0.1000 g aliquot delivered to Project 5.1a.

TABLE F.2 DISTRIBUTION OF MASS AND GAMMA ACTIVITY AMONG WET-SIEVED PARTICLE-SIZE FRACTIONS OF CLEAN SLATE 1 FALLOUT SAMPLES

CS I Sample BL-07

Tyler Mesh	Sieve Opening (Microns)	Weight Retained (Grams)	Percent Of Mass Retained	Cumulative Percent Of Mass Less Than Stated Size	Gamma And X-ray Activity	Percent Activity Retained	Cumulative Percent Of Activity Less Than Stated Size
24	710	0.2421	2.41	97.25	49,970	2.38	97.60
42	350	1.7807	17.7	79.50	852,100	40.63	56.97
65	210	1.2407	12.01	67.49	716,300	34.15	22.82
100	149	0.1551	1.55	65.94	124,600	5.94	16.88
150	105	0.3167	3.16	62.78	132,900	6.34	10.54
200	74	0.9585	9.55	53.23	72,560	3.46	7.08
325	44	1.8509	18.45	34.78	48,650	2.32	4.76
	40	0.4217	4.22	30.56	10,320	0.49	4.27
	30	0.5559	5.54	25.02	15,630	0.74	3.53
	20	0.5804	5.78	19.24	20,930	0.99	2.54
	10	0.7658	7.63	11.61	24,640	1.17	1.37
	(-10)	1.1647	11.61		28,430	1.36	0.01
Water	(-0.1)[a]				270	0.01	
TOTAL		10.0332[b]	99.66		2,097,300	99.98	

(a) 0.1 μ was calculated to be the maximum particle diameter that was not precipitated by centrifugation. Original weight at TTR before sieving was 11.192.

(b) 0.1000 g aliquot delivered to Project 5.1a.

TABLE F.2 CONTINUED

CS I Sample B-030

Tyler Mesh	Sieve Opening (Microns)	Weight Retained (Grams)	Percent Of Mass Retained	Cumulative Percent Of Mass Less Than Stated Size	Gamma And X-ray Activity	Percent Activity Retained	Cumulative Percent Of Activity Less Than Stated Size
24	710	0.0224	2.11	97.88	222	0.08	99.91
42	350	0.1203	11.34	86.54	47,550	17.45	82.46
65	210	0.1539	14.51	72.03	101,420	37.22	45.24
100	149	0.0775	7.31	64.72	59,157	21.71	23.53
150	105	0.0453	4.27	60.45	19,080	7.00	16.53
200	74	0.0865	8.15	52.30	13,570	4.98	11.55
325	44	0.1636	15.43	36.87	13,880	5.09	6.46
Pan	(-44)	0.3910	36.87		17,122	6.28	0.18
Water	(-0.1)[a]	———	———		487	0.18	
TOTAL		1.0605[b]	99.99		272,488	99.99	

(a) 0.1 μ was calculated to be the maximum particle diameter that was not precipitated by centrifugation.
Original weight at TTR
before sieving was 1.2478 .

(b) 0.1000 g aliquot delivered to Project 5.1a.

TABLE F.2 CONTINUED

CS I Sample D-030

Tyler Mesh	Sieve Opening (Microns)	Weight Retained (Grams)	Percent Of Mass Retained	Cumulative Percent Of Mass Less Than Stated Size	Gamma And X-ray Activity	Percent Activity Retained	Cumulative Percent Of Activity Less Than Stated Size
24	710	0.0387	1.75	98.21	322	0.10	100.40
42	350	0.0736	3.34	94.87	24,480	8.29	92.11
65	210	0.1812	8.21	86.66	119,100	40.37	51.74
100	149	0.0413	1.87	84.79	32,732	11.09	40.65
150	105	0.1066	4.83	79.96	37,543	12.72	27.93
200	74	0.2552	11.57	68.39	47,230	16.01	11.92
325	44	0.4498	20.39	48.00	15,070	5.10	6.82
	40	0.0835	3.78	44.22	2,450	0.83	5.99
	30	0.1775	8.05	36.17	3,200	1.08	4.91
	20	0.1889	8.57	27.60	3,240	1.09	3.82
	10	0.2598	11.78	15.82	3,860	1.31	1.97
	(-10)	0.3197	14.49	1.33	5,660	1.92	0.05
Water	(-0.1)[a]	0.0294	1.33		147	0.05	
TOTAL		2.2052[b]	99.96		295,034	99.96	

(a) 0.1 μ was calculated to be the maximum particle diameter that was not precipitated by centrifugation. Original weight at TTR before sieving was 2.6894.

(b) 0.1000 g aliquot delivered to Project 5.1a.

TABLE F.2 CONTINUED

CS I Sample H-030

Tyler Mesh	Sieve Opening (Microns)	Weight Retained (Grams)	Percent Of Mass Retained	Cumulative Percent Of Mass Less Than Stated Size	Gamma And X-ray Activity	Percent Activity Retained	Cumulative Percent Of Activity Less Than Stated Size
24	710	0.0339	1.66	98.33	587	0.19	99.79
42	350	0.1236	6.06	92.27	1,608	0.52	99.27
65	210	0.3525	17.29	74.98	19,030	6.12	93.15
100	149	0.3375	16.56	58.42	89,211	28.69	64.46
150	105	0.2085	10.23	48.19	98,742	31.76	32.70
200	74	0.1729	8.48	39.71	50,310	16.18	16.52
325	44	0.2617	12.84	26.87	23,600	7.59	8.93
Pan	(-44)	0.5478	26.87		27,320	8.79	0.14
Water	(-0.1)[a]				456	0.14	
TOTAL		2.0384[b]	99.99		310,864	99.98	

(a) 0.1 μ was calculated to be the maximum particle diameter that was not precipitated by centrifugation. Original weight at TTR before sieving was 2.2004.

(b) 0.1000 g aliquot delivered to Project 5.1a.

TABLE F.3 DISTRIBUTION OF MASS AND GAMMA ACTIVITY AMONG WET-SIEVED PARTICLE-SIZE FRACTIONS OF CLEAN SLATE II FALLOUT SAMPLES

CS II Sample BL-10(a)

Tyler Mesh	Sieve Opening (Microns)	Weight Retained (Grams)	Percent Of Mass Retained	Cumulative Percent Of Mass Less Than Stated Size	Gamma And X-ray Activity	Percent Activity Retained	Cumulative Percent Of Activity Less Than Stated Size
24	710	0.0032	0.05	99.93	47	0.11	100.02
42	350	0.0233	0.35	99.58	209	0.50	99.52
65	210	0.2581	3.84	95.74	503	1.22	98.30
100	149	0.1561	2.32	93.42	524	1.27	97.03
150	105	1.0404	15.48	77.94	3,804	9.25	87.78
200	74	1.6514	24.58	53.36	4,927	11.98	75.80
325	44	1.7628	26.23	27.13	10,388	25.26	50.54
	40	0.1512	2.25	24.88	1,865	4.51	46.03
	30	0.2374	3.53	21.35	3,360	8.17	37.86
	20	0.2755	4.09	17.26	4,660	11.33	26.53
	10	0.2710	4.03	13.23	3,520	8.56	17.97
	(-10)	0.8892	13.23		6,860	16.68	1.11
Water	(-0.1)(a)				460	1.11	
TOTAL		6.7196	99.98		41,127	99.95	

(a) 0.1 μ was calculated to be the maximum particle diameter that was not precipitated by centrifugation. Original weight at TTR before sieving was 464.8. (Only an aliquot was sieved.)

TABLE F.3 . CONTINUED

CS II Sample A-030(a)

Tyler Mesh	Sieve Opening (Microns)	Weight Retained (Grams)	Percent Of Mass Retained	Cumulative Percent Of Mass Less Than Stated Size	Gamma And X-ray Activity	Percent Activity Retained	Cumulative Percent Of Activity Less Than Stated Size
24	710	0.0160	0.19	99.79	115	0.13	99.87
42	350	0.0246	0.29	99.50	114	0.13	99.74
65	210	0.7025	8.45	91.05	6,634	7.61	92.13
100	149	1.6497	19.86	71.19	15,600	17.89	74.24
150	105	2.0388	24.54	46.65	18,640	21.39	52.85
200	74	2.1332	25.68	20.97	18,450	21.17	31.68
325	44	1.1418	13.74	7.23	17,640	20.24	11.44
Pan	(-44)	0.6007	7.23		9,240	10.60	0.84
Water	(-0.1)[a]	———	———		728	0.84	
TOTAL		8.3073	99.98		87,161	100.00	

(a) 0.1 μ was calculated to be the maximum particle diameter that was not precipitated by centrifugation.
Original weight at TTR before sieving was 137.2 . (Only an aliquot was sieved.)

TABLE F.3 CONTINUED

CS II Sample D-030

Tyler Mesh	Sieve Opening (Microns)	Weight Retained (Grams)	Percent Of Mass Retained	Cumulative Percent Of Mass Less Than Stated Size	Gamma And X-ray Activity	Percent Activity Retained	Cumulative Percent Of Activity Less Than Stated Size
24	710	0.0110	0.23	99.75	351	0.18	99.82
42	350	0.0168	0.35	99.40	102	0.05	99.93
65	210	0.0244	0.51	98 89	527	0.27	99.66
100	149	0.0096	0.21	98.68	393	0.21	99.45
150	105	0.0715	1.50	97.18	1,650	0.86	99.24
200	74	0.3824	8.03	89.15	2,072	1.06	98.38
325	44	0.9989	20.98	68.17	86,128	44.97	97.32
	40	0.3305	6.94	61.23	9,246	4.83	52.35
	30	0.6910	14.51	46.72	25,150	13.13	34.39
	20	0.5476	11.50	35.22	19,870	10.37	24.02
	10	0.5423	11.39	23.83	15,710	8.20	15.82
	(-10)	1.1347	23.83		27,610	14.41	1.41
Water	(-0.1)(a)	____	____		2,700	1.41	
TOTAL		4.7607	99.98		191,509	99.95	

(a) 0.1 μ was calculated to be the maximum particle diameter that was not precipitated by centrifugation.
Original weight at TTR
before sieving was 8.520.

TABLE F.3 CONTINUED

CS II Sample H-030

Tyler Mesh	Sieve Opening (Microns)	Weight Retained (Grams)	Percent Of Mass Retained	Cumulative Percent Of Mass Less Than Stated Size	Gamma And X-ray Activity	Percent Activity Retained	Cumulative Percent Of Activity Less Than Stated Size
24	710	0.0540	2.12	97.97	105	0.29	99.69
42	350	0.0575	2.26	95.71	220	0.63	99.06
65	210	0.1297	5.09	90.62	332	0.95	98.11
100	149	0.0437	1.71	88.91	136	0.38	97.73
150	105	0.1172	4.60	84.31	611	1.74	95.99
200	74	0.3137	12.31	72.00	3,560	10.14	85.85
325	44	0.4751	18.65	53.25	6,617	18.85	67.00
Pan	(-44)	1.3567	53.25		23,210	66.13	0.87
Water	(-0.1)(a)	____	____		306	0.87	
TOTAL		2.5476	100.09		35,097	99.98	

(a) 0.1 μ was calculated to be the maximum particle diameter that was not precipitated by centrifugation. Original weight at TTR before sieving was 2.8908.

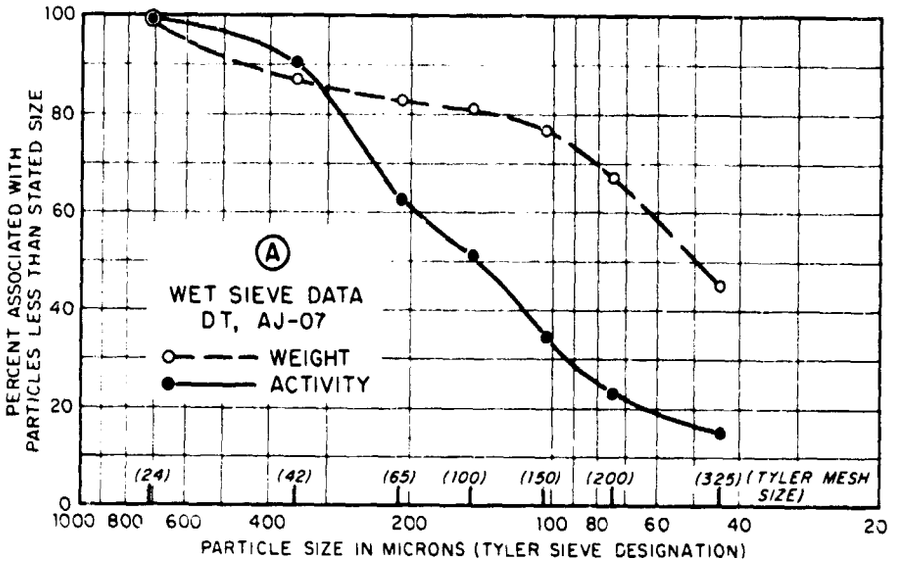


Figure F.1 (A) Sample AJ-07.

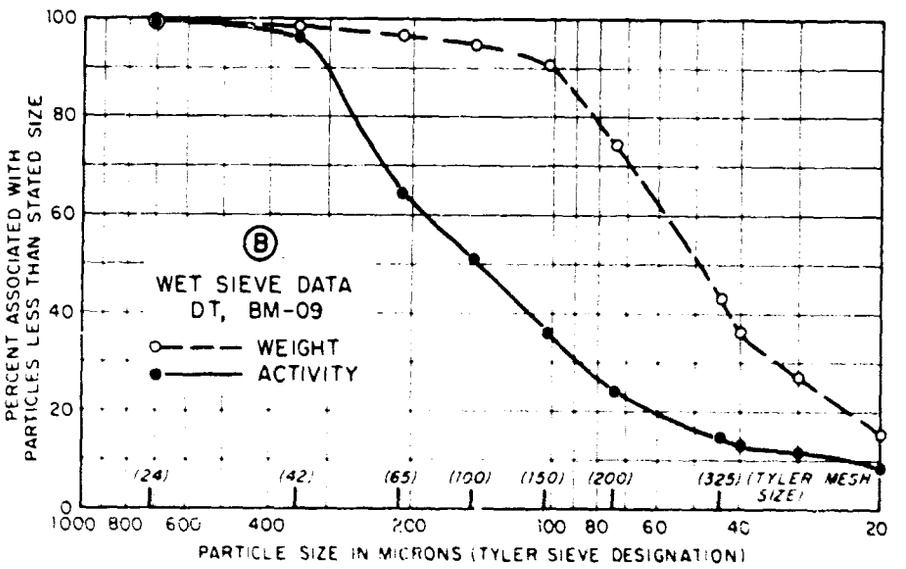


Figure F.1 (B) Sample BM-09.

Figure F.1 Distribution of mass and gamma activity among wet-sieved particle-size fractions of Double Tracks fallout samples.

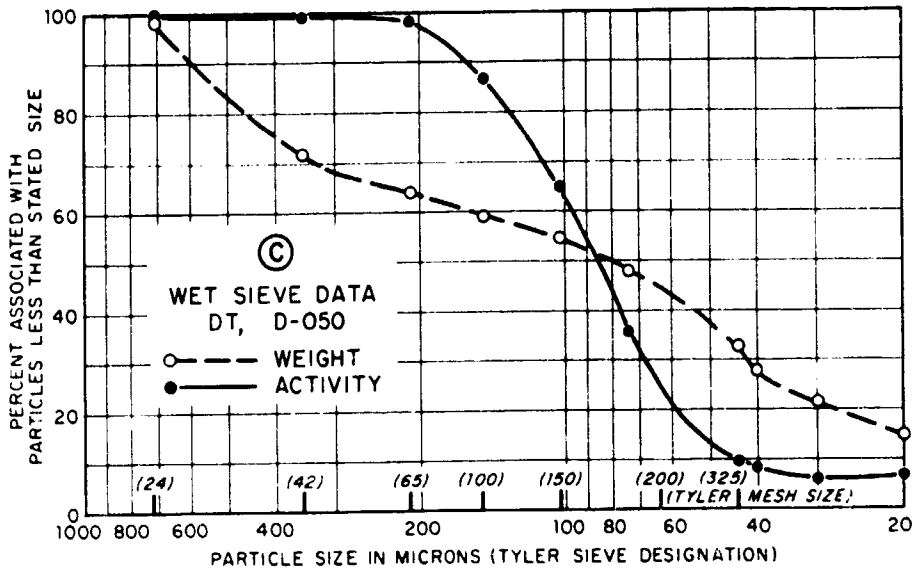


Figure F.1 (C) Sample D-050.

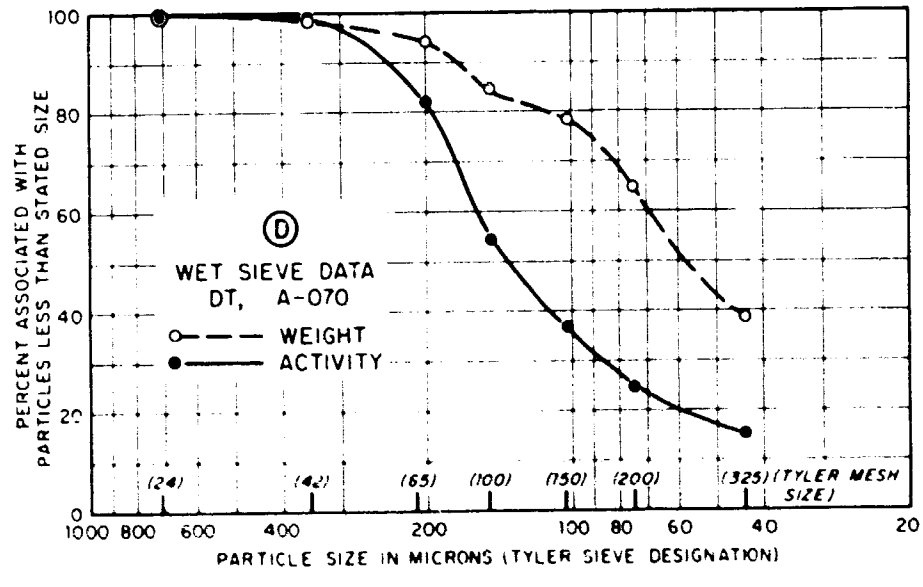


Figure F.1 (D) Sample A-070.

Figure F.1 Continued.

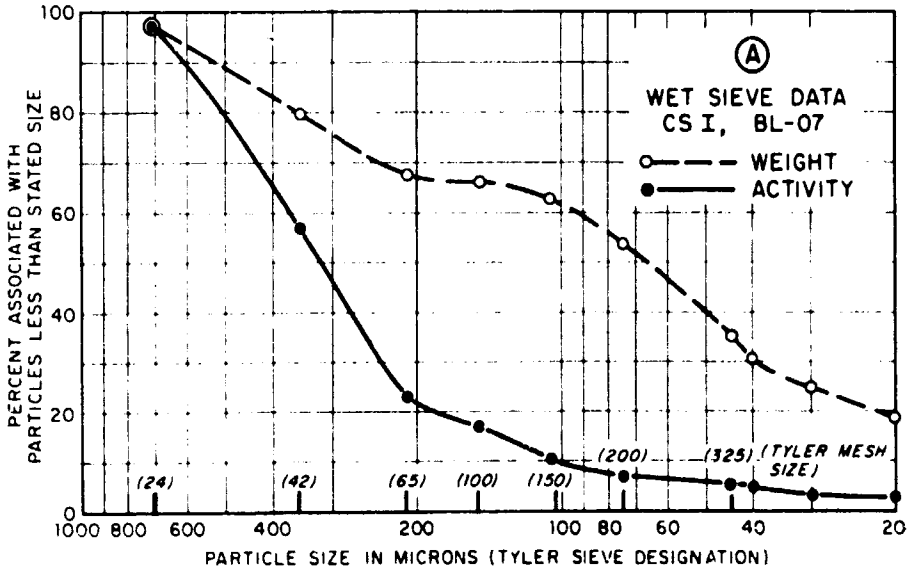


Figure F.2 (A) Sample BL-07.

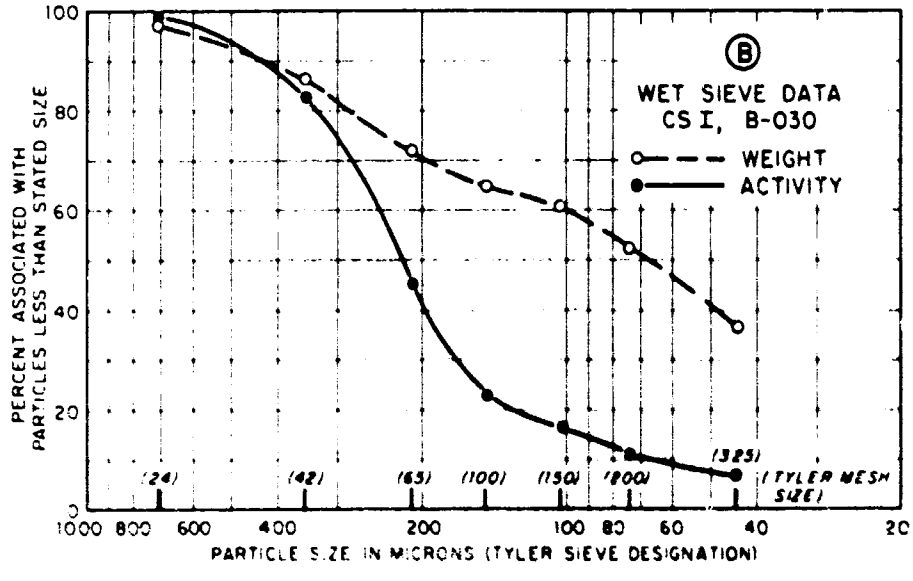


Figure F.2 (B) Sample B-030.

Figure F.2 Distribution of mass and gamma activity among wet-sieved particle-size fractions of Clean Slate I fallout samples.

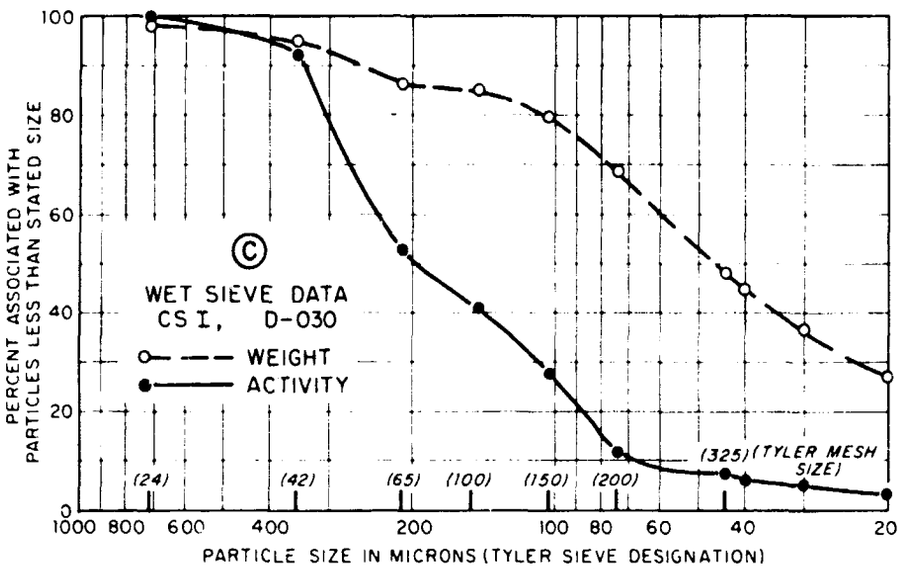


Figure F.2 (C) Sample D-030.

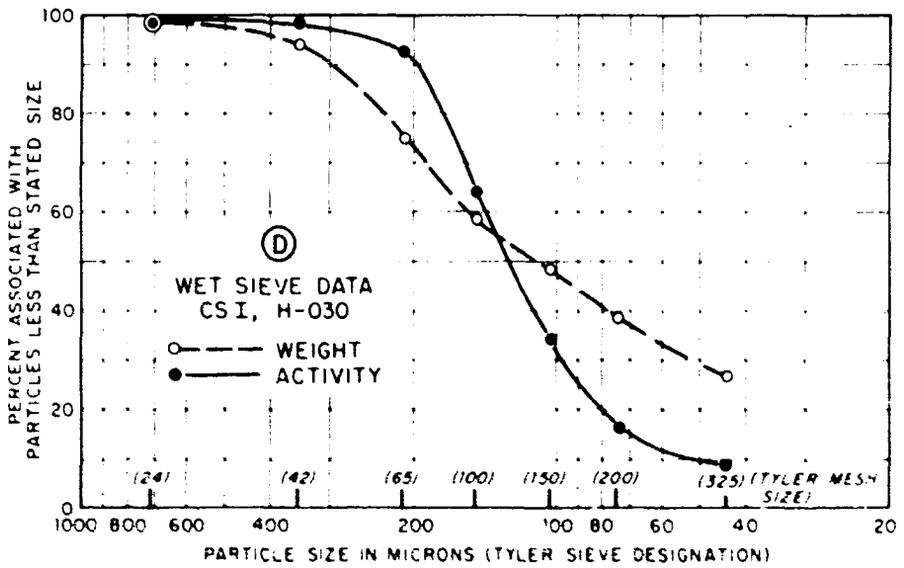


Figure F.2 (D) Sample H-030.

Figure F.2 Continued.

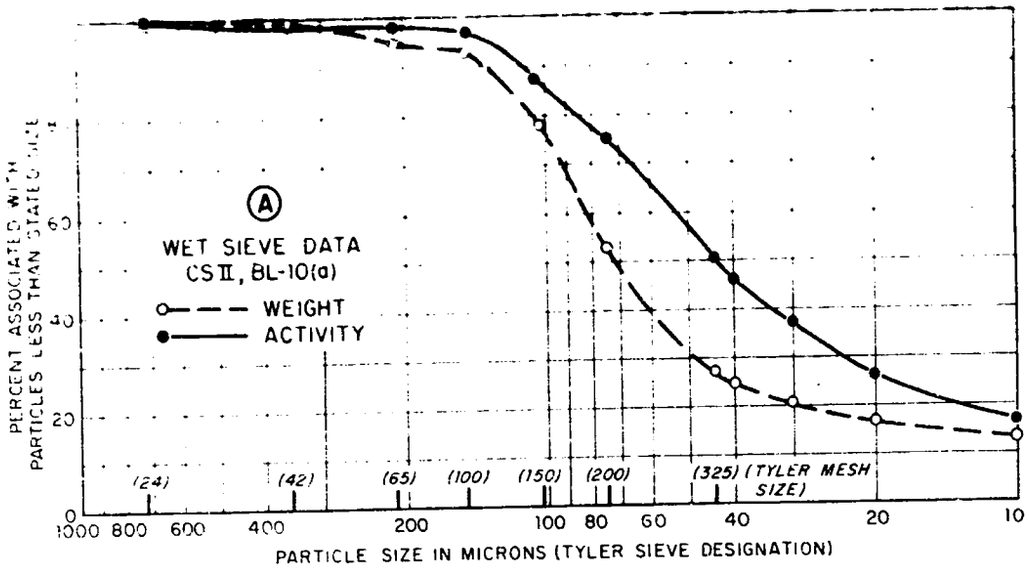


Figure F.3 (A) Sample BL-10(a).

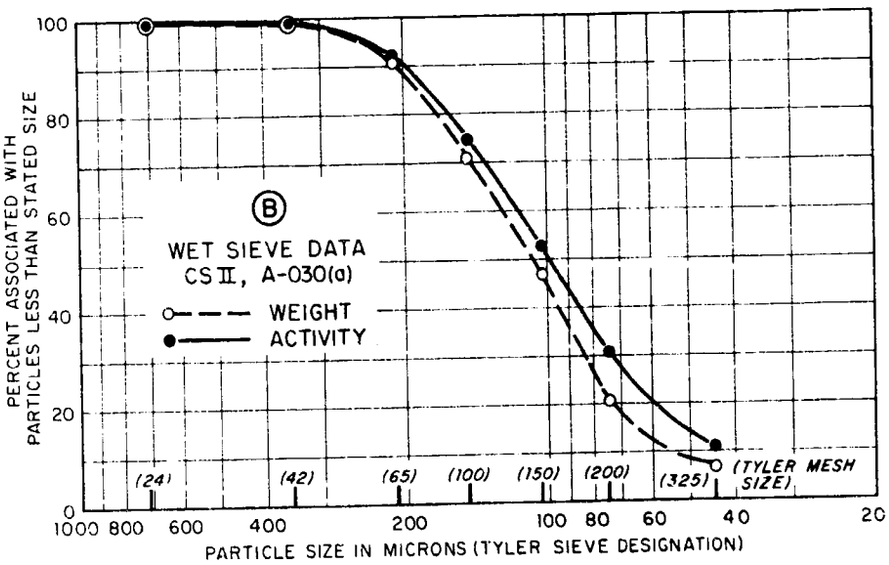


Figure F.3 (B) Sample A-030(a).

Figure F.3 Distribution of mass and gamma activity among wet-sieved particle-size fractions of Clean Slate II fallout samples.

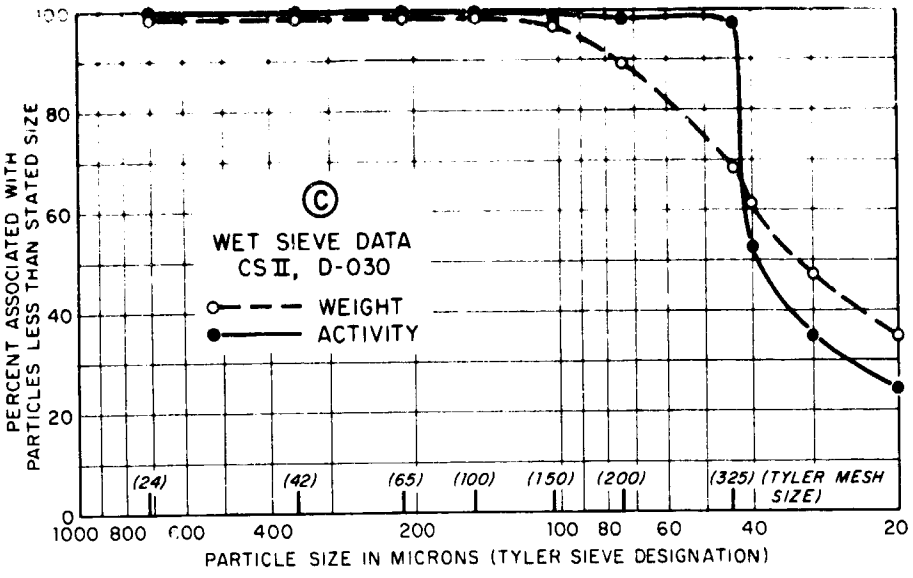


Figure F.3 (C) Sample D-030.

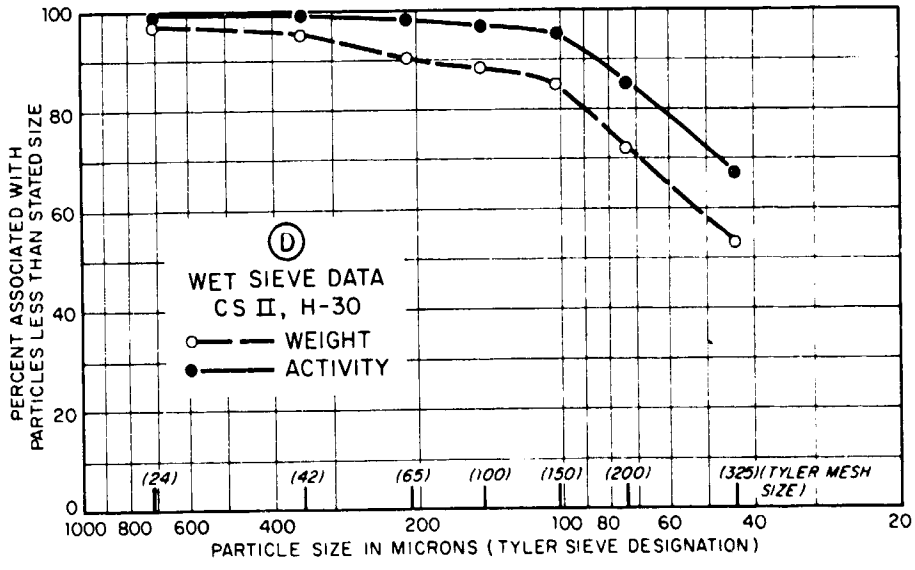


Figure F.3 (D) Sample H-30.

Figure F.3 Continued.

APPENDIX G

PHOTOMICROGRAPHS OF DOUBLE TRACKS WET-SIEVED FALLOUT SAMPLE D-050

Sample DT D-050 was obtained from 1,250 feet downwind. Photomicrographs were taken to ascertain the efficiency of wet-sieving to separate fallout into discrete particle-size fractions. The photomicrographs in Figure G.1 indicate that separation was successful.

Figure G.1 (a) Photomicrograph DT D-050 +24 mesh (wet sieved) (≥701μ)

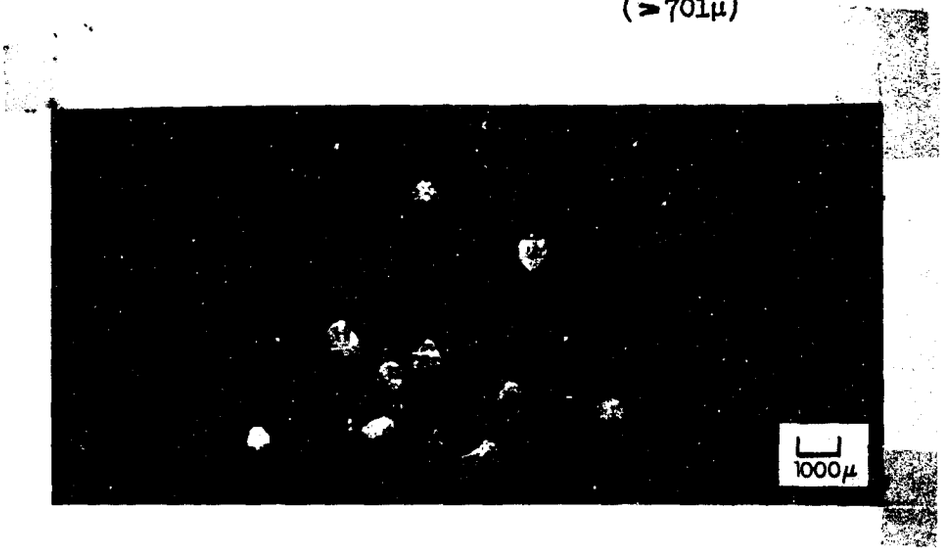


Figure G.1 (b) Photomicrograph DT D-050 +42 mesh (wet sieved) (350 to 701μ)

Figure G.1 Photomicrographs of Double Tracks wet-sieved fallout sample D-050.

Figure G.1 (c) Photomicrograph DT-050 +65 mesh (wet sieved) (208 to 350μ)

Figure G.1 (d) Photomicrograph DT-050 +100 mesh (wet sieved) (149 to 208μ)

Figure G.1 Continued.

Figure G.1 (e) Photomicrograph DT D-050 +150 mesh (wet sieved) (105 to 149μ)

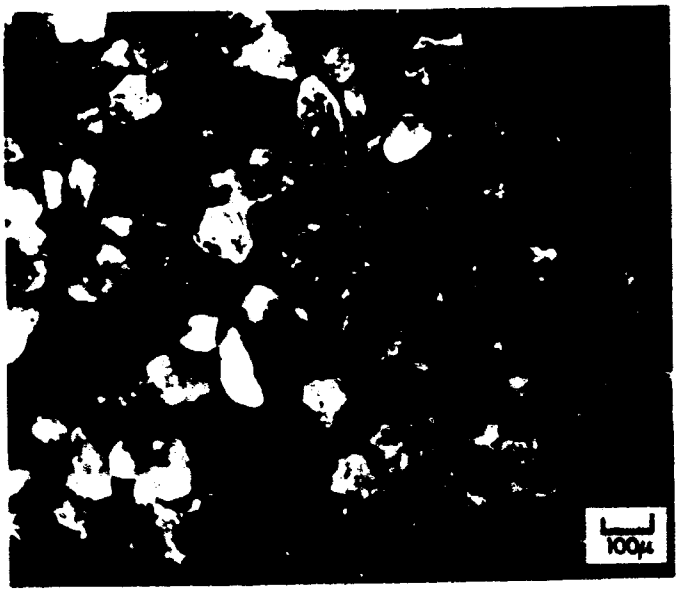


Figure G.1 (f) Photomicrograph DT D-050 +200 mesh (wet sieved) (74 to 105μ)

Figure G.1 Continued.

Figure G.1 (g) Photomicrograph DT D-050 +325 mesh (wet sieved) (44 to 74μ)

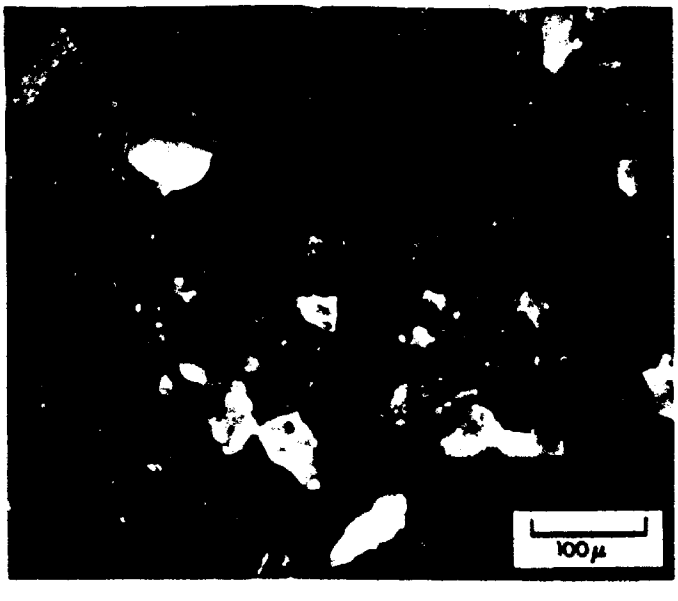


Figure G.1 (h) Photomicrograph DT D-050 +40 μ (wet sieved) (40 to 44μ)

Figure G.1 Continued.

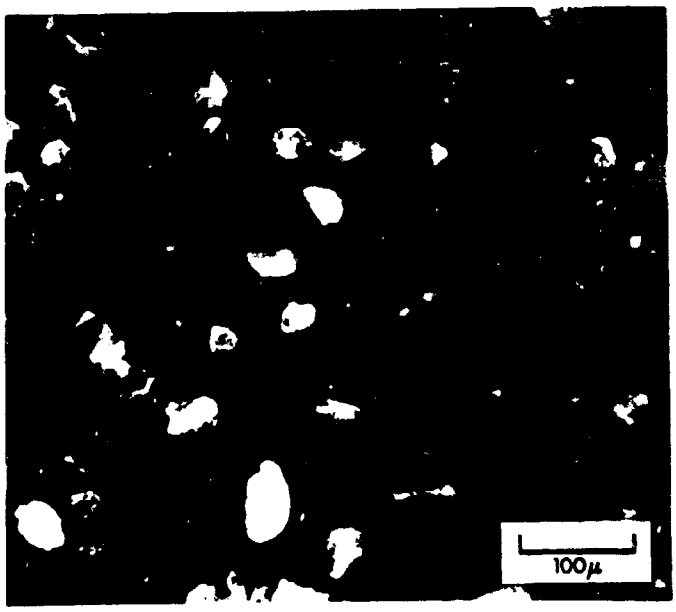


Figure G.1 (i) Photomicrograph DT D-050 +30 μ (wet sieved) (30 to 40μ)

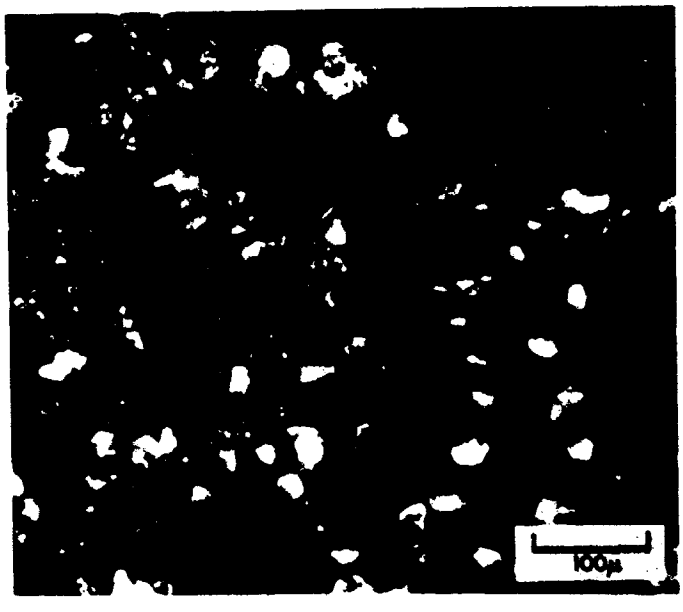


Figure G.1 (j) Photomicrograph DT D-050 +20 μ (wet sieved) (20 to 30μ)

Figure G.1 Continued.

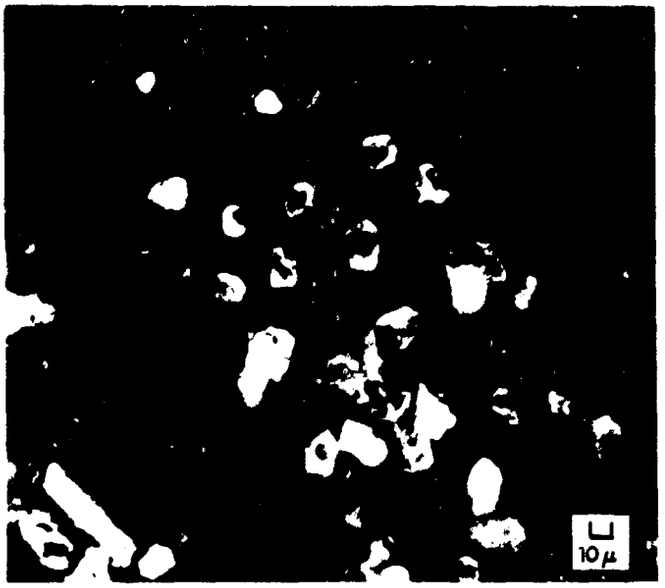


Figure G.1 (k) Photomicrograph DT D-050 +10 μ (wet sieved) (10 to 20μ)

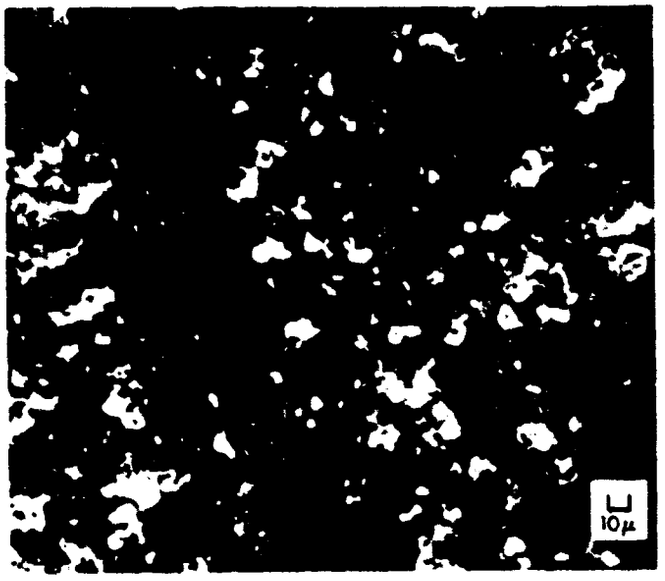


Figure G.1 (l) Photomicrograph DT D-050 -10 μ (wet sieved)

Figure G.1 Continued.

APPENDIX H

RESULTS OF GAMMA AND X-RAY PULSE-HEIGHT ANALYSES FOR Pu^{239} AND Am^{241} BY NRDL AND GA

The activities in the 17-kev Pu^{239} photopeak and in the 60-kev Am^{241} photopeak found at NRDL are tabulated.

The amount of Pu^{239} and Am^{241} in each sample was determined from the 60-kev peak based upon the count rate of the sample of the source material with known Pu^{239} content. The 60-kev peak was only slightly affected by the mass of the sample for samples weighing less than 10 grams. The activity observed in the 17-kev peak was so seriously affected by sample mass that determining Pu^{239} directly from this X-ray was not feasible.

Comparative Am^{241} results (by gamma spectrometry) from GA are included and they averaged 30.0 ± 8.6 percent higher than NRDL results. Aliquots of the same Am^{241} solution were used as reference counting standards by both NRDL and GA (Tables H. 1 through H.3).

TABLE H.1 SUMMARY OF GAMMA AND X-RAY PULSE-HEIGHT ANALYSES, DOUBLE TRACKS

Sample No.	Particle Size	Weight	Activity in Channels 26-85 (17-kev Peak)	Activity in Channels 86-200 (60-kev Peak)	Pu^{239} µg/Sample NRDL	Am^{241} 10^{-4}µg/Sample NRDL	Am^{241} 10^{-4}µg/Sample GA
	(µ)	(g)	(cpm)	(cpm)			
AJ-07	Total	3.50	377,200	1,815,900	3052	69.36	
BM-09	Total (before sieving)	3.32	209,600	1,021,500	1702	38.91	
BM-09	+350	0.0461	13,700	39,800	62.4	1.382	
BM-09	+210	0.1510	87,900	372,800	588.9	12.98	17.59
BM-09	+149	0.0471	34,900	141,200	221.3	4.905	
BM-09	+105	0.1237	42,700	164,800	259.6	5.737	7.98
BM-09	+ 74	0.4617	42,900	151,400	239.9	5.383	
BM-09	+ 44	0.8871	18,200	81,500	130.4	2.958	3.83
BM-09	Pan (before sub-sieving)	1.3427	41,800	157,800	255.8	5.788	
BM-09	+40	0.2108	4,400	15,400	24.2	0.5386	
BM-09	+30	0.2699	7,400	21,600	34.2	0.7602	0.90
BM-09	+20	0.3195	10,900	29,100	46.1	1.037	
BM-09	+10	0.2229	11,700	28,900	45.6	1.016	1.23
BM-09	- 10	0.2204	20,300	50,500	79.6	1.774	
A-070	Total	0.93	175,400	768,500	1237	27.84	
C-060	Total	4.71	27,300	146,600	248.2	5.726	
D-050	Total (before sieving)	1.42	56,200	254,100	411.8	9.327	
D-050	+149	0.0573	7,900	24,900	39.0	0.8651	
D-050	+105	0.526	13,100	47,000	73.6	1.671	
D-050	+ 74	0.0818	71,200	226,000	355.4	7.874	
D-050	+ 44	0.1818	15,500	59,700	94.0	2.091	
D-050	Pan	0.4337	14,500	52,900	83.8	1.879	

TABLE H.2 SUMMARY OF GAMMA AND X-RAY PULSE-HEIGHT ANALYSES, CLEAN SLATE I

Sample No.	Particle Size	Weight	Activity in Channels 26-85 (17-kev Peak)	Activity in Channels 86-200 (60-kev Peak)	Pu^{239} µg/Sample NRDL	Am^{241} 10^{-2} µg/Sample NRDL
	(µ)	(g)	(cpm)	(cpm)		
AH-06 (aliq)		4.65	61,800	322,300	551.9	12.58
AH-06 "	#2	10.00	121,700	724,100	1341	29.49
AH-06 "	#4	7.274	80,200	476,000	850	19.03
BL-07	Total (before sieving)	10.692	266,600	1,630,000	3052	67.10
BL-07	+710	0.2421	9,700	38,400	60.6	1.353
BL-07	+350	1.7807	173,200	884,000	1439	32.74
BL-07	+210	1.2407	139,300	724,700	1173	26.55
BL-07	+149	0.1551	21,700	101,400	160.7	3.532
BL-07	+105	0.3167	24,800	104,400	170.5	3.779
BL-07	+ 74	0.9585	13,200	59,200	95.4	2.148
BL-07	+ 44	1.8509	8,700	38,900	63.7	1.442
BO-06 (aliq)		0.1000	7,600	26,500	41.8	0.9235
B-030	Total	1.1478	45,300	198,900	319.8	7.273
D-030	Total (before sieving)	2.5894	44,800	219,100	361.5	8.227
D-030	+350	0.0736	5,100	18,400	28.8	0.6396
D-030	+210	0.1812	22,400	93,500	147.2	3.273
D-030	+149	0.0413	6,400	24,900	38.9	0.8632
D-030	+105	0.1066	8,500	28,800	45.3	1.005
D-030	+ 74	0.2552	9,900	36,000	56.8	1.260
D-030	+ 44	0.4498	3,100	11,500	18.2	0.4070
D-030	Pan	1.1307	3,500	13,000	20.9	0.4745
F-030	Total	1.6813	65,400	277,200	450.0	9.736
H-030	Total	2.10	54,800	239,600	392.8	8.921

TABLE H.3 SUMMARY OF GAMMA AND X-RAY PULSE-HEIGHT ANALYSES, CLEAN SLATE II

Sample No.	Particle Size	Aliquot No.	Weight	Activity in Channels 26-85 (17-kev Peak)	Activity in Channels 86-200 (60-kev Peak)	Pu^{239} µg/Sample NRDL	Am^{241} 10^{-2} µg/Sample NRDL	GA
	(µ)		(g)	(cpm)	(cpm)			
AJ-08(a)	Total		10.10	5,130	25,710	41.9	1.048	
BL-10(a)	Total (before sieving)		8.16	5,050	25,060	45.0	1.007	
BL-10(a)	+105		1.04	720	2,910	4.69	0.1063	
BL-10(a)	+ 74		1.65	930	3,890	6.29	0.1437	
BL-10(a)	+ 44		1.76	1,820	7,690	12.97	0.2845	
BL-10(a)	Pan		1.86	3,270	13,090	21.41	0.4852	
BL-10(a)		2	10.00	6,950	36,210	67.1	1.475	
BL-10(a)		10	10.00	6,920	35,320	65.4	1.439	
BL-10(a)		20	10.00	6,780	35,520	65.8	1.446	
BL-10(a)		30	10.00	6,620	35,230	65.2	1.435	
BL-10(a)		40	10.00	6,714	34,580	64.0	1.408	
BL-10(a)		42	10.00	6,940	35,740	66.2	1.456	
BL-10(b)		1	10.00	8,830	47,020	87.1	1.915	
BL-10(b)		5	10.00	9,210	47,070	87.2	1.917	
BL-10(b)		7	10.00	9,250	48,010	88.9	1.955	
BL-10(b)		9	10.00	9,010	47,910	88.7	1.951	
BO-04(a)	Total		9 19	11,400	58,880	107.8	2.381	
A-030(a)			8.52	11,660	58,500	105.8	2.358	
A-030(a)		2	10.00	13,920	72,240	133.7	2.942	
A-030(a)		6	10.00	13,420	72,350	134.0	2.947	
A-030(a)		10	10.00	13,210	71,840	133.0	2.926	
A-030(a)		12	10.00	13,770	72,410	134.1	2.949	

TABLE H.3 CONTINUED

Sample No.	Particle Size	Aliquot No.	Weight	Activity in Channels 26-85 (17-kev Peak)	Activity in Channels 86-200 (60-kev Peak)	Pu^{239} µg/Sample NRDL	$\frac{Am^{241}}{NRDL}$	10^{-2} µg/Sample $\frac{}{G\ell}$
	(µ)		(g)	(cpm)	(cpm)			
A-030(b)		1	10.00	26,627	145,982	270.3	5.945	
A-030(b)		3	10.00	28,010	146,134	270.6	5.952	
A-030(b)		5	10.00	27,262	150,342	278.4	6.123	
C-030	Total		14.02	38,712	208,726	413.3	9.075	12.37
D-030	Total (before sieving)		8.52	26,591	134,423	243.1	5.417	
D-030	325		4.00	13,926	68,769	116.4	2.651	
D-030	Pan		3.35	16,427	67,604	113.1	2.572	
H-030	Total		2.89	8,050	25,200	41.8	0.9515	

APPENDIX I

RESULTS OF NEUTRON-ACTIVATION ANALYSES

The results of the neutron-activation analyses for Pu^{239}, U^{235}, and U^{238} reported by General Atomic are tabulated in Tables I.1 through I.3. The results of the analyses of known samples were 113 ± 14 percent of the known plutonium content.

TABLE I.1 RESULTS OF NEUTRON-ACTIVATION ANALYSES OF KNOWN STANDARDS

General Atomic Number	NRDL Designation	Isotope and Its Weight	Soil Added	Pu^{239}	Pu^{239} in Total Sample *	Weight Ratio Pu (analyzed) / Pu (known)	U^{238} *	U^{235} *	Weight Ratios U^{235}/U^{238}
		μg	g	μg/g	μg		μg/g	μg/g	
201	I AR Pu	50.0 μg purified Pu^{239}	None		66.6 ± 24	1.33	N.D. (< 3.7 μg total)	Not Requested (N.R.)	
203	II AR Pu+Am	50 μg purified Pu^{239} + 0.0125 μg Am^{241}	None		61 ± 2.1	1.22	N.R.	N.R.	
202	III AR Pu + Am + Soil	50 μg purified Pu^{239} + 0.0125 μg Am^{241} + 10 grams Soil †	10 grams	6.47 ± 0.30	64.7	1.29	15.2 ± 0.4	$1.09 \pm 0.03 \times 10^{-1}$ μg/g	0.0072
204	IV Am	0.0125 μg purified Am^{241}	None		N.D. $< 5.8 \times 10^{-3}$		N.R.	N.R.	
205	Pu	10 μg RC Pu	None		9.87 ± 0.29	0.99	N.D. (< 0.45 μg total)	N.R.	
206	Pu + dep U ‡	10 μg RC Pu + 10.7 μg dep U ‡	None		10.2 ± 0.6	1.02	8.34 ± 0.40 μg (total)	$1.67 \pm 0.08 \times 10^{-2}$ μg (total)	0.002
207	Dep U ‡	10.7 μg dep U ‡	None	N.R.	N.R.		8.45 ± 0.14 μg (total)	$1.69 \pm 0.03 \times 10^{-2}$ μg (total)	0.002
208	No. 6 Std	100 μg RC Pu + Soil †	10 grams	10.3 ± 0.5	103	1.03	6.24 ± 0.62		
215	UCRL Pu-105	105 μg Pu (Not RC)	None		127 ± 4	1.21	N.D. (< 5.1 μg total)		
216	RC - D(1)	100 μg RC Pu	1 gram	93.5 ± 2.7	93.5 ± 2.7	0.93	N.D. (< 5.5 μg total)		

* Error estimate from counting statistics only (±1 S.D.).
† CS I background soil from Station AJ-06.
‡ 0.20 percent U^{235}; 99.8 percent U^{238}.

TABLE L2 RESULTS OF NEUTRON-ACTIVATION ANALYSES OF BACKGROUND SOILS

General Atomic Number	Event Area	Station Number	Particle Size	U^{238} *	U^{235} *
			μ	$\mu g/g$	$\mu g/g$
16	DT	AJ-06		15.5 ± 1.5	$1.12 \pm 0.11 \times 10^{-1}$
No number	CS I	AH-06		13.8 ± 0.2	Not determined
14	CS I	AJ-06		14.0 ± 0.4	$1.01 \pm 0.3 \times 10^{-1}$
15	CS II	BL-09		21.8 ± 1.5	$1.57 \pm 0.11 \times 10^{-1}$
17	−325 mesh Montmorillonite Clay			8.75 ± 0.23	$6.30 \pm 0.17 \times 10^{-2}$
20	DT	AJ-06	210 to 350	18.0 ± 1.6	$1.07 \pm 0.38 \times 10^{-1}$
22	DT	AJ-06	105 to 149	38.7 ± 1.6	$1.46 \pm 0.37 \times 10^{-1}$
24	DT	AJ-06	44 to 88	23.8 ± 1.8	$1.18 \pm 0.38 \times 10^{-1}$
26	DT	AJ-06	30 to 40	28.5 ± 1.5	$1.28 \pm 0.38 \times 10^{-1}$
28	DT	AJ-06	10 to 20	31.1 ± 1.3	$1.33 \pm 0.37 \times 10^{-1}$
30	DT	AJ-06	−10	26.4 ± 0.8	$1.23 \pm 0.36 \times 10^{-1}$

* Error estimate is ±1 S.D. (from counting statistics only).

TABLE I.3 RESULTS OF NEUTRON-ACTIVATION ANALYSES OF ROLLER COASTER FALLOUT SAMPLES

General Atomic Number	Event	Station Number	Particle Size	Original Weight of Sample	Weight Sent to GA	Pu^{239} * †	U^{238} * †	U^{235} * † ¶
			μ		g	μg/g	μg/g	μg/g
3	DT	BM-09	+210	NA	0.1510	$4.58 \pm 0.15 \times 10^3$	$1.06 \pm 0.01 \times 10^4$	21.4 ± 0.3
5	DT	BM-09	+105	NA	0.1237	$2.48 \pm 0.08 \times 10^3$	$1.04 \pm 0.01 \times 10^4$	21.0 ± 0.3
7	DT	BM-09	+74	NA	0.8871	168 ± 5	$6.39 \pm 0.06 \times 10^3$	12.9 ± 0.2
9	DT	BM-09	+30	NA	0.2699	124 ± 4	$2.00 \pm 0.02 \times 10^3$	4.09 ± 0.04
11	DT	BM-09	+10	NA	0.2229	213 ± 4	$1.24 \pm 0.02 \times 10^3$	2.56 ± 0.05
12	DT	BM-09	−10	NA	0.2204	358 ± 13	$1.08 \pm 0.02 \times 10^3$	2.24 ± 0.06
211	DT	B-070		3.36	2.98	123 ± 5	$6.57 \pm 0.09 \times 10^2$	1.39 ± 0.04
212	DT	C-070		3.88	3.85	25.6 ± 2.6	$1.40 \pm 0.02 \times 10^2$	0.35 ± 0.04
213	CS I	BO-06		2.7738	2.5316	425 ± 16	$1.35 \pm 0.02 \times 10^4$	27.1 ± 0.4
214	CS I	C-030		3.3994	3.3782	123 ± 4	$5.55 \pm 0.06 \times 10^3$	11.2 ± 0.2
210	CS II	B-030		59.450	10.0	26.2 ± 0.8	$2.26 \pm 0.02 \times 10^3$	4.58 ± 0.06
209	CS II	C-030		15.1360	14.0214	29.0 ± 0.9	$2.63 \pm 0.03 \times 10^3$	5.34 ± 0.06
217	CS II	F-030		9.3694	8.15	21.8 ± 0.7	$1.79 \pm 0.01 \times 10^3$	4.04 ± 0.05
102	DT ‡ leach (−74μ material) 1-week water leach	Material washed through 74-μ mesh sieve when this sample was treated as if it had been mixed with clay			~0.01	148 ± 8 (0.015 μg total)	$1.55 \pm 0.02 \times 10^3$ (15 μg total)	12.9 ± 0.2 (0.13 μg total)
104	DT leach (1-week water and clay)	Montmorillonite clay after separation from +74-μ fallout			~1	10.4 ± 0.7	296 ± 4	0.66 ± 0.04

* Error estimate is ± 1 S.D. (from counting statistics only).

† Reported by GA.

‡ DT BM-09; 74-μ to 88-μ fraction: it contained 520 μg Pu per gram of sample before leaching (from Table H.1).

¶ U^{236}/U^{238} is near 0.2 for all samples: this reflects the fact that nearly all the uranium came from the devices (background was only about 10 μg U^{238} per gram of soil).

APPENDIX J

RESULTS OF RADIOCHEMICAL ANALYSES OF FALLOUT SAMPLES

Some fallout samples, or aliquots of samples, from the large-area (aluminum) collectors were analyzed by the Project 5.2/5.3 radiochemical analytical contractors, and the results are compiled in Tables J.1 through J.3. They are compared with other plutonium data in Section 3.11. The Pu^{239} content of some samples was determined by gamma spectrometry by EIC and H-NSC; these results are also included.

The plutonium data herein are reported only for that portion of the sample that was delivered to the contractor. The original weight or total weight of the deposited fallout at each station is listed in Appendix D.

TABLE J.1 RESULTS OF RADIOCHEMICAL ANALYSES OF DOUBLE TRACKS FALLOUT SAMPLES

Sample Number	T-Lab Number	Weight (g)	Pu^{239} (μg)(1)	Plutonium Contractor	U(5) (μg)	Uranium Contractor
AH-05	9814	12.50	212	T Lab		
AH-06	9815	1.0000	89.2	T Lab		
AJ-04	9813	4.52	2.6(2)	I I		
AJ-05	9813	4.58	10.9(2)	I I	0.426(6)	T Lab
AJ-06	9813	6.00	56.3(2)	I I		
AJ-07	9815	1.0000	900	T Lab		
AJ-08	9813	3.05	8.4(2)	I I		
BK-07	9812	3.95	7.3	H-NSC		
BK-08	9812	3.02	16.0	H-NSC		
BL-07	9811	2.45	5.3	H-NSC		
BL-08	9811	2.25	34.4	H-NSC	5500	H-NSC
BL-09	9815	1.0000	204	T Lab		
BM-08	9810	2.40	9.0(2)	EIC		
BO-10	9809	1.45	7.2(2)	EIC		
A-060	9808	1.05	8.1(2)	EIC		
A-070	9815	0.1000	80.0	T Lab		
A-080	9808	0.81	1.4	EIC		
B-060	9807	2.83	17.2(2)	EIC		
C-050	9806	3.52	64.1	T Lab		
C-060	9815	0.1000	3.8	T Lab		
C-060	-	4.61	204	T Lab		
D-050	9815	0.1000	58.2(2)(4)	T Lab		
D-060	None	2.33	144	H-NSC		
D-070	9805	1.07	5.7(2)	EIC		

(1) The weight of plutonium was calculated by multiplying the dpm reported by each Project 5.2/5.3 analytical contractor by 6.89×10^{-6} μg/dpm ($Pu^{239,240}$).
(2) These results are subject to re-evaluation; private communication, H. E. Menker, Roller Coaster Evaluation Team, February 1965.
(3) Results not available as of 23 November 1964.
(4) Derived from activity of 60-kev Am^{241} gamma ray by H-NSC.
(5) Natural uranium content not subtracted.
(6) The validity of these results is uncertain because the samples were subjected to error-producing chemical and physical pretreatment before being analyzed for uranium.

TABLE J.2 RESULTS OF RADIOCHEMICAL ANALYSES OF CLEAN SLATE I FALLOUT SAMPLES

Sample Number	T-Lab Number	Weight (g)	Pu^{239} (μg)(1)	Plutonium Contractor	U(5) (μg)	Uranium Contractor
AH-06	9829	2.0000	9.6(2)	EIC		
BK-05(7)	9835	10.38	11.7	T Lab		
BK-06	9835	12.42	289	T Lab		
BK-08	9835	21.48	4330(4)	H-NSC		
BK-09	9835	27.45	268	T Lab		
BL-05		7.05	7.2(2)	I I		
BL-06		8.03	210(2)	I I		
BL-07	9829	0.5000	10.5(2)	EIC		
BL-08	9831	6.02	387	I I (2)	0.594(6)	T Lab
BL-09	9831	6.60	52.5	I I (2)	0.928(6)	T Lab
BM-05	9833	3.00	307	H-NSC		
BM-07	9833	4.28	1082	H-NSC	14,400	H-NSC
BM-09	9833	6.30	41.3	H-NSC		
BO-04	9832	2.69	446	H-NSC		
BO-06	9829	0.1000	(3)	EIC		
BO-08	9832	3.1	54.4	H-NSC		
A-020	9830	1.1462	592	H-NSC	11,260	H-NSC
A-040	9830	0.7213	69.5	I I	0.466(6)	T Lab
A-050	9830	0.7331	13.4	I I		
A-060	9830	0.8284	5.4	I I		
B-040	9817	1.7661	3.4(2)	EIC		
C-020	9834	3.60	88.3(4)	H-NSC		
F-030	None	1.68	368	T Lab		
H-030	9829	0.1000	1.8(2)	EIC		

(1) The weight of plutonium was calculated by multiplying the dpm reported by each Project 5.2/5.3 analytical contractor by 6.89×10^{-6} μg/dpm ($Pu^{239,240}$).
(2) These results are subject to re-evaluation; private communication, H. E. Menker, Roller Coaster Evaluation Team, February 1965.
(3) Results not available as of 23 November 1964.
(4) Derived from activity of 60-kev Am^{241} gamma ray by H-NSC.
(5) Natural uranium content not subtracted.
(6) The validity of these results is uncertain because the samples were subjected to error-producing chemical and physical pretreatment before being analyzed for uranium.

TABLE J.3 RESULTS OF RADIOCHEMICAL ANALYSES OF CLEAN SLATE II FALLOUT SAMPLES

Sample Number	Aliquot Number	T-Lab Number	Weight (g)	Pu^{239} (μg)(1)	Pu^{239} (μg) by Gamma Spectrometry	Pluto-nium Contractor	$U^{(5)}$ (μg)	Uranium Contrac-tor
BL-10(a)	2	None	10.00	54.4	69(2)	T-Lab		
BL-10(a)	10	None	10.00	51.6	52(2)	T-Lab		
BL-10(a)	20	None	10.00	50.6	51(2)	T-Lab		
BL-10(a)	30	None	10.00	53.0	50(2)	T-Lab		
BL-10(a)	40	None	10.00	52.9	50(2)	T-Lab		
BL-10(a)	42	None	10.00	51.5	51(2)	T-Lab		
BL-10(b)	1	None	10.00	67.8	67(2)	T-Lab		
BL-10(b)	5	None	10.00	68.7	63(2)	T-Lab		
BL-10(b)	7	None	10.00	71.0	62(2)	T-Lab		
BL-10(b)	9	None	10.00	71.0	65(2)	T-Lab		
BL-10(a)		9842	1.00	4.9		T-Lab		
B0-04(a)		9842	1.0000	12		T-Lab		
A-030(a)	2	None	10.00		105(3)			
B-030		9842	1.0000	23.3		T-Lab		
B-040		9843	27.9	488		H-NSC		
B-050		9843	16.05	298		H-NSC		
B-070		9843	5.71	86.7	86.8(3)	H-NSC		
B-080		9843	3.79	36.8		H-NSC	303	H-NSC
B-090		9843	4.37	21.6		H-NSC		
C-030		9842	1.0000	24.2		T-Lab		
C-040		9792	9.2329	198		T-Lab		
C-050		9792	7.3642	125		T-Lab		
C-070		9792	6.7352	48.8		T-Lab		
C-080		9792	6.6960	27.7(6)		T-Lab		
C-090		9792	4.3312	16.6(6)		T-Lab		
D-040		9845	4.0031	94.3		H-NSC		
D-050		9845	2.7217	54.4		H-NSC		
D-070		9845	1.5510	18.3		I I	0.143(4)	T-Lab
D-080		9845	1.6076	16.8(6)		H-NSC		
D-090		9845	1.5529	13.1(6)		H-NSC		
F-030		9842	1.0000	18.0		T-Lab		
F-040		9846	8.9788	59.2		T-Lab		
F-050		9846	1.2090	10.6(6)		T-Lab		
F-060		9846	1.0032	7.0(6)		T-Lab		
F-080		9846	2.0294	4.0(6)		T-Lab		
F-090		9846	0.8818	2.3(6)		T-Lab		

TABLE J.3 CONTINUED

Sample Number	Aliquot Number	T-Lab Number	Weight (g)	Pu^{239} (μg)(1)	Pu^{239}(μg) by Gamma Spectrometry	Plutonium Contractor	U(5) (μg)	Uranium Contractor
H-040		9844	3.38	26.2(6)		H-NSC		
H-050		9844	2.08	31.0(6)		H-NSC		
H-070		9844	2.17	10.0(6)		H-NSC		
H-080		9844	3.08	9.9(6)		H-NSC		
H-090		9844	3.14	9.0(6)		H-NSC		

(1) The weight of plutonium was calculated by multiplying the dpm reported by an analytical contractor by 6.89×10^{-6} μg/dpm ($Pu^{239,240}$).
(2) From 60-Kev Am^{241} photopeak; EIC.
(3) From 60-kev Am^{241} photopeak; H-NSC.
(4) The valicity of these requests is uncertain because the sample was subjected to error-producing chemical and physical pretreatments before being analyzed for uranium.
(5) Natural uranium background not subtracted.
(6) These results are subject to re-evaluation; private communication, H. E. Menker, Roller Coaster Evaluation Team, February 1965.

APPENDIX K

GAMMA ACTIVITY OF ALIQUOTS OF DRY SAMPLES

Seven samples, at least one from each event, were divided into weighed aliquots of 10 grams or less. Each aliquot was gamma counted and the results as well as the averages and standard deviations are tabulated in Table K.1.

TABLE K.1 GAMMA ACTIVITY OF ALIQUOTS OF DRY SAMPLES

Event	Station Number	Aliquot Number	Aliquot Weight (g)	Specific Activity (cpm/g)
+74-μ Leach Sample[1]		1	1.00	115,000[2]
" " "		2	"	164,000
" " "		3	"	142,000
" " "		4	"	158,000
" " "		5	"	120,000
" " "		6	"	138,000
" " "		7	"	123,000
" " "		8	"	128,000
" " "		9	"	120,000
" " "		10	"	127,000
" " "		11	"	120,000
" " "		12	"	109,000
" " "		13	"	146,000
" " "		14	"	165,000
" " "		15	"	126,000
" " "		16	"	134,000
Average				133,440 ± 17,400 (13 %)
-74-μ Leach Sample[1]		1	1.00	89,700[3]
" " "		2	"	88,000
" " "		3	"	86,800
" " "		4	"	89,800
" " "		5	"	92,700
" " "		6	"	90,500
" " "		7	"	90,700
" " "		8	"	89,700
Average				89,700 ± 1,800 (2 %)
CS I	AH-06	1	10.000	74,200
"	"	2	"	71,700
"	"	3	"	73,500
"	"	4	"	69,400
"	"	5	"	83,600
Average				74,500 ± 5,400 (7.2 %)
CS II	BL-10(a)	1	10.00	4,310
"	"	2	"	4,480
"	"	3	"	4,300
"	"	4	"	4,310
"	"	5	"	4,470
"	"	6	"	4,330

TABLE K.1 CONTINUED

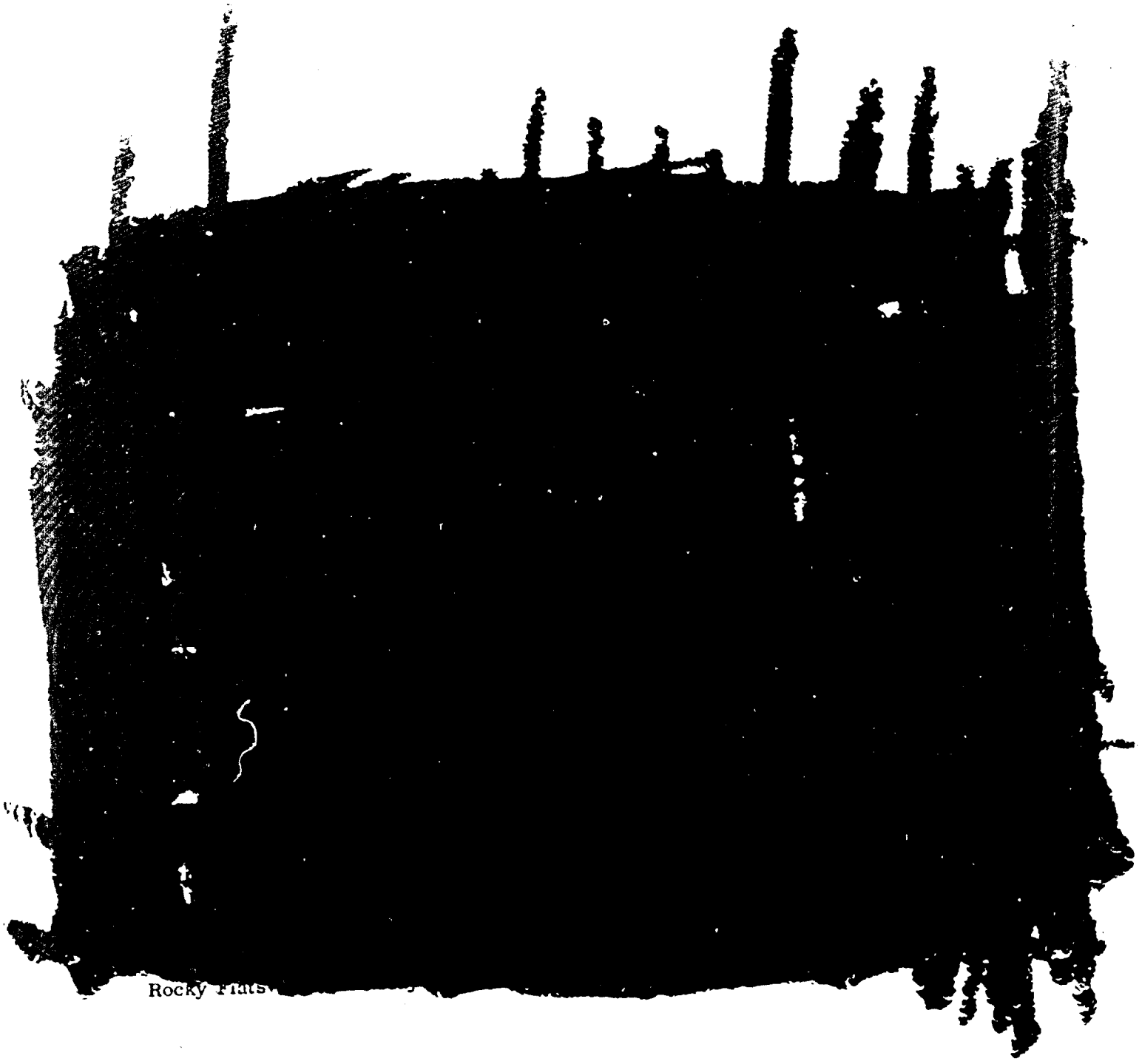
Event	Station Number	Aliquot Number	Aliquot Weight (g)	Specific Activity (cpm/g)
CS II	BL-10(a)	7	10.00	4,360
"	"	8	"	4,280
"	"	9	"	4,400
"	"	10	"	4,420
"	"	11	"	4,390
"	"	12	"	4,380
"	"	13	"	4,290
"	"	14	"	4,370
"	"	15	"	4,460
"	"	16	"	4,340
"	"	17	"	4,370
"	"	18	"	4,510
"	"	19	"	4,320
"	"	20	"	4,400
"	"	21	"	4,360
"	"	22	"	4,460
"	"	23	"	4,370
"	"	24	"	4,380
"	"	25	"	4,240
"	"	26	"	4,320
"	"	27	"	4,400
"	"	28	"	4,410
"	"	29	"	4,310
"	"	30	"	4,380
"	"	31	"	4,320
"	"	32	"	4,380
"	"	33	"	4,260
"	"	34	"	4,250
"	"	35	"	4,570
"	"	36	"	4,340
"	"	37	"	4,390
"	"	38	"	4,410
"	"	39	"	4,420
"	"	40	"	4,290
"	"	41	"	4,310
"	"	42	"	4,430
"	"	43	"	4,210
"	"	44	"	4,340
"	"	45	"	4,360
"	"	46	7.00	4,700
Average				4,370 ± 70 (1.6 %)

TABLE K.1 CONTINUED

Event	Station Number	Aliquot Number	Aliquot Weight (g)	Specific Activity (cpm/g)
CS II	BL-10(b)	1	10.00	5,770
"	"	2	"	5,910
"	"	3	"	5,920
"	"	4	"	5,830
"	"	5	"	5,820
"	"	6	"	5,910
"	"	7	"	5,910
"	"	8	"	5,870
"	"	9	"	5,900
"	"	10	"	5,920
"	"	11	"	5,910
Average				5,880 ± 50 (0.9 %)
CS II	A-030(a)	1	10.00	8,660
"	"	2	"	9,030
"	"	3	"	8,800
"	"	4	"	8,930
"	"	5	"	9,000
"	"	6	"	8,820
"	"	7	"	8,780
"	"	8	"	9,120
"	"	9	"	8,870
"	"	10	"	8,760
"	"	11	"	8,820
"	"	12	"	8,830
"	"	13	8.97	8,610
"	"	14	8.16	8,840
Average				8,850 ± 160 (1.8 %)
CS II	A-030(b)	1	10.00	17,290
"	"	2	"	17,280
"	"	3	"	17,180
"	"	4	"	17,420
"	"	5	"	17,790
"	"	6	"	16,360
"	"	7	8.37	17,200
Average				17,210 ± 370 (2.1 %)

(1) Mixture of DT samples AH-06, AH-07, BK-09 and BL-09.
(2) From Table 3.6.
(3) From Table 3.7.

(a) Throwout material that slid from aluminum collector when it was tipped vertically.
(b) Material that adhered to the petrolatum surface of the aluminum collector after it had been tipped vertically.



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